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THE AMERICAN JOURNAL OF ROENTGENOLOGY

Editor, James T. Case, M.D., Battle Creek, Mich.

VOL. V (NEW SERIES) JANUARY, 1918 No. 1

OUR PREPARATION FOR THE X-RAY WORK OF THE WAR*

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THE medical profession of the United States has reason to feel proud of its response to the call to national service. At the present time more than one-tenth of the total number of physicians in this country have received commissions in the Medical Officers Reserve Corps. It is safe to say that this is equaled by no other profession or class. The doctor has been called upon to make immense sacrifices since, in most cases, his income depends entirely upon his own personal efforts and stops when he enters the service. He has been actuated by a high sense of patriotic duty, and has responded to the country's call until there is now little fear that the number will not be sufficient for all needs.

This is true not only of the general profession, but also of the several specialties, and is particularly applicable to the one we represent. The American Roentgen Ray Society was one of the first of the national societies to realize the necessity for making preparation for the part its members were to take in the inevitable struggle. Months before war was declared, the president of the society, Major Cole of New York, ably seconded by Major Manges of Philadelphia, who has since succeeded Major Cole as president, and assisted by a Committee of Preparedness, carried on a propaganda to interest the roentgenologists of the country in military roentgenology. It was soon discovered by this committee that the number of qualified roentgenologists in the United States was comparatively small and that some plan would need to be devised to train men for this work. It had been emphasized by surgeons and roentgenologists who had returned from active service in Europe that the best work in the localization of foreign bodies could be hoped for only if the roentgenologist were a trained physician. A non-medical technician or mechanician, however skilled, could not possibly coöperate with the surgeon as could the roentgenologist with broad medical training.

By the advice, then, of the Committee of Preparedness, the Surgeon General's Office decided that the *x*-ray work in all military hospitals, both in this country

*Read before the Philadelphia Roentgen Society, December 12, 1917.

and abroad, would be directly in charge of medical roentgenologists. The problem then was to get a large number of men in training immediately for this work. This same committee, acting with representatives from the Surgeon General's Office, then organized schools for instruction in military roentgenology in nine different cities in various parts of the country. In each of these cities instructors were selected who had adequate hospital facilities available. These instructors met in New York and, after an extended conference, laid out a course of instruction to be followed at all of the schools. The instructors were all commissioned in the Medical Reserve Corps and assigned to duty for this special work. Selected students, who were also commissioned in the Reserve Corps, were then ordered to report to these instructors for courses of varying length, dependent upon the ability and previous experience of the student. Even men with much previous experience in *x*-ray work have found these courses of great value.

The roentgenologist who goes to foreign service soon finds that his work differs greatly from that of civil practice, and that his special training in military roentgenology is invaluable.

Up to the present about two hundred men have finished the course of training at these schools and are well qualified for their special work. Some of them are already in France and others are doing the great amount of *x*-ray work called for at the various base and general hospitals in this country.

It now seems expedient to concentrate the work of instruction at the school in New York City, where we have assembled and equipped for operation all of the various types of apparatus adopted for use in the service. The plan now also includes a preliminary course at one of the Medical Officers Training Camps located at Fort Oglethorpe, Georgia, and Fort Riley, Kansas. At these camps the doctor, fresh from civil practice, finds himself immediately in a military atmosphere, a part of a military organization, and under the guidance of a trained corps of instructors who have become specialists in different branches of medical military work. Roentgenologists will now enter the service through these training camps and, after one month's instruction in the general training provided at the camp, will undergo another month's training in roentgenology under an experienced instructor who will be sent to the camp for that purpose. At the end of this time those who are considered eligible will be sent for final training to the school in New York.

When the schools for instruction were first established we were greatly handicapped by lack of any precedent for our guidance and by the fact that none of our otherwise experienced roentgenologists had had special experience in roentgenology as applied to military conditions. It was believed, however, that much good would be accomplished by attempting to standardize the methods of *x*-ray men who had had considerable experience in general *x*-ray work and this belief has been justified by the results. Many roentgenologists have now finished the course of instruction and are all much better qualified to carry out their work in military hospitals than they were before, although they had had previously many years' experience in *x*-ray work.

We have now reached the time when we must draw largely from among men with relatively little experience, but our curriculum and methods of teaching are well established and we feel confident that a sufficient number of men can be prepared to do efficiently the *x*-ray work of the war. The lack of experience in strictly military roentgenology is not now so apparent because Major James T. Case has recently returned from France, where he was in charge of *x*-ray work with the American Expeditionary Forces. He will be in conference for some time with the instructors in this country in order to make all methods directly applicable to conditions as they exist at the front.

The work of instruction will now be greatly facilitated also by the publication of a "Manual of *X*-Ray Work," originally conceived by the Committee of Preparedness of the American Roentgen Ray Society, and contributed to by a number of the prominent *x*-ray men of the country.

In addition to training medical men who are to be the directors of the *x*-ray laboratories, it has been found necessary to train men in the purely technical part of the work, that is the development of plates, the care of the *x*-ray apparatus, and the many routine duties about an *x*-ray laboratory. Men for this duty have been drawn from the enlisted personnel of the Medical Department and given a course of training at the Army Medical School in Washington. We have also found it necessary to secure the services of men who have had factory experience in order to provide for the installation and repair of our great mass of highly specialized apparatus. Men for this purpose have been commissioned in the Sanitary Corps.

Great strides have been made in the perfection and standardization of apparatus. It was realized at the beginning of the war that little change would be necessary in the apparatus used in civilian hospitals in order to adapt it to the large base and general hospitals of the army. The principal necessity was to standardize this apparatus in order to facilitate its manufacture in sufficient quantity, and to insure the elimination of unnecessary parts. A committee appointed by the Council of National Defense early last spring recommended a list of apparatus and supplies for use at base and general hospitals which has been closely adhered to up to the present time. Experience at the cantonment hospitals in this country and in the base hospitals already in France has suggested certain modifications and additions to the list and to the specifications. This revision will be completed within a few days, and, being the product of experience both at home and abroad, will, we hope, serve as an adequate standard throughout the war.

A very important addition to the apparatus of stationary hospitals is the "bedside unit." The necessity for being able to make *x*-ray examinations of a large number of patients without moving them from bed has been emphasized by many observers in France. This applies particularly to fractures of the hip and thigh and is practically always a fluoroscopic examination. Major Case now reports that fluoroscopic examinations of the chest are also made quite routinely in military hospitals in France without moving the patient away from his bed. The bedside unit adopted for our army has been developed by Major J. S. Shearer, S. C., Professor of Physics at Cornell University, who has been at the head of the teaching force at the School for Instruction in Military Roentgenology in New York City. This unit is so constructed as to be readily wheeled to the bedside, and to operate on any type of current either direct or alternating. Major Shearer has made use, for the bedside unit, of a special radiator type of Coolidge tube developed by Dr. Coolidge for use with the army portable apparatus. The radiator on this tube provides for the rapid cooling of the target so that the tube can rectify its own current. The addition of this bedside unit so completes the *x*-ray equipment of stationary hospitals as to leave little to be desired. The equipment of stationary hospitals, however, is only the beginning of the problem of furnishing adequate *x*-ray facilities for the examination of the wounded.

It is now thoroughly recognized that the wounded man's chances for recovery bear a very close relation to the time which elapses before he can receive adequate surgical care and be placed at rest in comfortable surroundings. The recognition of this fact has brought about the erection of evacuation hospitals much nearer to the firing line than was formerly thought feasible. These hospitals are so constucted and equipped that it is possible in them to

give all necessary surgical treatment to practically all wounds, including the removal of foreign bodies. These semi-permanent evacuation hospitals are now placed, in certain instances, as near to the front as the very mobile field hospitals were in previous wars. It was never deemed advisable to place *x*-ray apparatus of any description in hospitals which were not equipped for the rendering of surgical aid, and which were too mobile to permit those operated upon to rest comfortably for sufficient time after operation. It is now possible to make efficient use of the *x*-ray at a much earlier stage in the treatment of the wounded than was formerly the case because of the erection of these advanced evacuation hospitals, corresponding to the British "casualty clearing stations." The *x*-ray apparatus for such a hospital must be more portable than a base hospital equipment, and must necessarily have its own source of power. No electric current will be available from local sources at such advanced posts.

Portable *x*-ray apparatus with its own power plant has been used by armies ever since the beginning of the Boer War. The earliest apparatus consisted of small induction coils with mechanical interrupters operated from storage batteries. Since that time many different types of mobile apparatus have been devised, some of them depending for power upon the motor of the automobile in which they were carried. None, however, have been free from serious defects.

In 1913 and 1914 a portable outfit was developed in the Medical Department of our own army by Major Wm. A. Duncan. This consisted of a gas engine of the marine type, operating a generator, on the shaft of which was a revolving disc for rectification of the current. This disc revolved in contact with brushes which were mounted directly on the box containing the transformer. This apparatus has been used on the Mexican border and at some posts in the army where local current supply was not available, but has never come into very general use because of its great weight, its relatively small output of current, and its liability to get out of repair. The necessity for a more readily portable and more reliable apparatus was apparent. The needs in this direction became known to Dr. Coolidge and he set himself the task of developing such an apparatus. Fortunately, he was able to secure a widely used gas engine which, with a few modifications, was readily adapted to the purpose. He succeeded in eliminating all moving parts from the apparatus by a radical modification of the Coolidge tube whereby it was rendered capable of rectifying its own current. A description in detail of this portable *x*-ray outfit will be published at an early date by Dr. Coolidge. It admirably fills the army needs for this type of apparatus since it is light, readily transportable in an ambulance or a small truck, gives sufficient output of current, and, above all, is exceedingly reliable. It is adapted for use in the evacuation hospitals mentioned before, or can be carried in a truck or trailer as the *x*-ray equipment of one of the automobile surgical units which are rapidly coming into use. The evacuation hospitals will each be equipped with as many of these portable outfits as seems necessary for the average amount of work. At times of unusual activity in a sector more of the portable outfits may be sent as separate units or forming a part of one or more automobile surgical units, which are brought up to increase the capacity of a particular evacuation hospital. The portable machine has even been found of real use in base hospitals as an accessory to the main apparatus, or as a substitute when the latter is out of order or when the current supply has failed.

We might continue this recital to tiresome length by describing the work that has been done in developing much accessory apparatus to render *x*-ray work on the wounded more rapid or more accurate. A large amount of work has been done on the *x*-ray table alone, upon the construction of which so largely depends the com-

fort of both the roentgenologist and the surgeon, as well as their safety from exposure to the ray. A table has now been devised which is very satisfactory from the standpoint of everyone, including the surgeon. Operating for the removal of foreign bodies under direct control of the *x*-ray has come to be a very common procedure at the front. For this reason it is necessary to have a table suitable both for operating and for *x*-ray examination. The top of such a table must, of course, be readily penetrable by the ray and, at the same time, should be strong and capable of resisting the action of liquids. The top finally decided upon was suggested by Capt. E. W. Caldwell of New York. It is called "bakelite," a substance made on a large scale in connection with the construction of aeroplanes, and is obtainable for our purpose in practically any quantity. It fulfills every requirement for the top of a combined *x*-ray and operating table.

I wish to mention only one other type of apparatus which is now almost complete and ready to be put into practical use. This is a stereoscopic fluoroscope designed by Captain Caldwell. A very large proportion of the *x*-ray work at the front is fluoroscopic. Only those who know by experience the difference between the image on the flat plate and that of the stereoscopic pair, can appreciate the really wonderful advance that is made when images on the fluorescent screen stand out with perfect stereoscopic effect. We confidently expect this to be one of America's great contributions for the assistance of the surgeon in his efforts to alleviate the condition of the wounded in war.

I wish to state in conclusion that this is the aim of all who are connected with this work—to be of the greatest possible assistance to the physician and the surgeon. We are training our men and constructing our apparatus with this single object,—to add to the comfort, the rapidity, and the accuracy of your work. We ask only that the surgeon will permit us to coöperate with him to the end that he may do better work, and especially that he will coöperate with us to bring about a standardization of the methods to be used when we are working together.

THE CAUSE AND PREVENTION OF THE CONSTITUTIONAL EFFECTS ASSOCIATED WITH THE MASSIVE DOSES OF DEEP ROENTGENOTHERAPY*

BY GEORGE E. PFAHLER, M.D.

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ACTING upon the request of your president to prepare a paper upon some therapeutic subject, I concluded that nothing under the heading of deep roentgenotherapy is as important as the study of the constitutional effects following massive doses of the roentgen rays. These effects are an annoying feature that has developed since the advent of the Coolidge tube, not because of the Coolidge tube, but because of the fact that by no other means can such massive doses be obtained in a reasonable period of time, and by no other means can a large quantity of high tension current be maintained for an indefinite time.

I took up this subject before the 16th annual meeting of this society at Atlantic City, September 22–25, 1915.[1] At this meeting I acted upon the theory that the effects were chiefly due to the inhalation of the gases produced as a result of the action of the high tension currents upon the air, and the dust contained in

[1] PFAHLER: "The Cause and Prevention of the Constitutional Effects Associated with the Massive Doses of Deep Roentgenotherapy."—*Am. Jour. of Roentgenol.*, Vol. III (new series), No. 6, pp. 310–313, June, 1916.

* Read before the Eighteenth Annual Meeting of the American Roentgen Ray Society, New York City, September 20–22, 1917.

the air. At the same meeting, Dr. Lange,[2] in dealing with the same subject, took the view that the effects were due to an acidosis, but presented no experimental or clinical proof of an acidosis other than that he believed he obtained relief of symptoms from the administration of large doses of bicarbonate of soda.

CONSTITUTIONAL EFFECTS OR SYMPTOMS

Not all patients are affected. The patient may show no effects whatever from a course of treatment, and then show pronounced effects from another course of treatment, and again subsequently show no effects from a similar amount of treatment given in a similar manner.

Briefly, the symptoms consist, in their mildest form, of a general discomfort, a languor, lose of appetite, or the patient may have a violent attack of vomiting with nausea, and in these severe cases the attack may last from a day to two weeks. The symptoms may come on in a few hours, or the next day. In some instances nausea and vomiting appear before the patient leaves the table, and, rarely, the treatment must be interrupted to allow the patient to vomit. In other instances, the patient feels perfectly well while lying on the table, but after he gets up and attempts to dress, he becomes ill. At times this vomiting is propulsive and, apparently without warning, the vomitus is thrown out in bulk upon the floor. In the severe cases the patient is bedfast for a week or two. During this time there is gradual improvement, but the associated prostration is marked. Frequently patients do not become nauseated as a result of the first or second course of treatment, but at the third or fourth develop the symptoms, and after the patient has once developed the constitutional effects, they certainly seem more susceptible to them subsequently.

Diarrhea has occurred rarely in connection with abdominal treatments, and when this symptom has developed it has usually lasted from several days to two weeks. This symptom of diarrhea seems to occur in patients who are subject to attacks of diarrhea from trivial causes. Therefore, I have not been entirely convinced that the diarrhea has been due to the treatment, though this would seem entirely possible.

Women are much more frequently affected than men. Abdominal cases seem more likely to be affected than others, but the breast cases are almost equally affected, and the symptoms may arise no matter what part of the body is treated.

THEORY AS TO CAUSE

As originally expressed in 1915, I still believe that the inhalation of the gases generated are the most important factor, though probably not the whole cause. I am led to this belief *first* because at the very beginning of these observations the patients complained of the odors of these gases, even before the constitutional symptoms were produced, and at a time when no effort was made to eliminate the odor of the gases, some patients saying that it took a week or two to get the odor out of their hair; *second*, patients have complained of nausea on entering the rooms; *third*, the patients most likely to be affected are those who have previously been affected by odorous gases, and those who are nervous, high strung or highly sensitive. One patient complained of the fact that since having developed nausea as a result of this gas that now the odor of the gasoline in the automobile produces nausea. One must not lose sight of the possibility of a psychical factor such as is illustrated by the complaint of a patient who reported to one of my colleagues that she became nauseated when she passed his office.

On the theory that the odor itself might be an important factor, I tried to overcome this odor by the free use of various perfumes, but without success. I believe, therefore, that the odor as such is not the cause.

[2] LANGE: "The Cause and Prevention of the Constitutional Symptoms Following Deep Roentgenotherapy."—*Am. Jour. of Roentgenol.*, Vol. III (new series), No. 7, pp. 356–358, July, 1916.

Acting upon the theory that if an acidosis is produced, it might be produced by the acidity of the gases, I therefore tried to neutralize this gas by the free use of ammonia gas flavored with smelling salts. This seemed to do some good, but the results obtained were not sufficient to prove it as a cause, and I believe that the improvement obtained was due chiefly to the stimulating effects of the smelling salts.

Immediately after the recommendation of Dr. Lange as to the administration of bicarbonate of soda, on the theory of acidosis, I gave the patients bicarbonate of soda according to Dr. Lange's recommendation, but I could see no appreciable difference in the frequency or severity of the symptoms, and after the patients begged me not to give it to them (some of them insisting that it was the bicarbonate of soda that made them ill), I discontinued. Acidosis as a cause has not been disproved by me, nor has it been proven by anyone else of whom I know. I am hoping that some competent laboratory worker will give us definite data on this point. Unfortunately our research staffs have been so badly depleted by the requirements of medical men in the present war that this point of investigation may have to be deferred. Fortunately, Van Slyke and Cullen [3] have devised a simple technique by means of which the capacity of the plasma to combine with carbonic acid (formed by carbon dioxid), under definite tension is determined as a measure of the alkali in excess of acids other than carbonic; and this more simple method of determining acidosis may enable us to prove this point at an early date. My lack of success with the alkaline treatment may be due to faulty administration, for our judgment as to the quantity needed is at present based upon very crude methods of observation.

After considering all phases of the subject, and making continual observation during the past two years, I am more and more convinced that the chief factor in the causation of these symptoms is the gases produced by the high tension currents or the combination of these gases with dust particles. This seems to me to be proven by the fact that the more completely corona is eliminated and the more thoroughly the air is changed, the less these symptoms develop, and by the fact that while originally about one in four patients developed these symptoms, now about one in ten, though we have not completely eliminated the gas nor have we completely eliminated the sickness.

Against this view is the observation made by Dr. Zulick and myself in one case —that of a woman treated for uterine fibroids—who became nauseated after each course of treatment. After the fourth course of treatment she was free from all symptoms, and free from any evidence of tumor, and seemed to be perfectly well. We, therefore, introduced a lead cover over the diaphragm of the tube, which the patient could not recognize, and which eliminated absolutely all rays from the patient, and then gave her exactly the same amount of treatment as had been given previously, and under as nearly similar conditions as possible. After this course of treatment she did not get sick. In this observation, however, one must recognize the fact that at this stage the patient was robust and free from all symptoms, and we dare not conclude that she would have become sick had we given her the roentgen ray treatment.

With the idea of obtaining some definite information from animal experiments, I made use of guinea pigs, using four full-grown guinea pigs that were believed to be thoroughly healthy. One was kept for control, and simply fed and in all other respects treated the same as the pigs under treatment.

Pig No. 1 was placed in a box in which the pig could only breathe air and gas which was forced into the box by a rotary pump which removed the gas from the box containing the high tension rotary switch.

[3] Van Slyke, D.D., and Cullen, G.E.: "Studies of Acidosis, I, The Bicarbonate Concentration of the Blood Plasma, Its Significance, and Its Determination as a Measure of Acidosis."—*Jour. Biol. Chem.*, 1917, 30, 289.

After inhaling this gas continuously for two hours, it was inactive, but immediately began to eat when placed in the food box. This pig, which weighed two pounds at the beginning, lost 2½ ounces in the first twenty-four hours, and subsequent treatments with this gas seemed to have no further effect. The pig inhaled this gas for 2½ hours continuously during the period of four days, after which the experiment was abandoned, for this gas on this pig seemed to have no effect.

Pig No. 2, weighing 19 ounces, was exposed on August 6, 1917 to the roentgen rays for two hours—5 milliamperes, 9″ parallel spark, at a distance of 8″, and 6 millimeters of aluminum and glass as a filter. After this exposure this pig seemed more lively than Pig No. 1, which was receiving the gas at the same time, but did not eat for a half hour, though the next morning it seemed normal. The pig lost 1½ ounces in the first 24 hours. On August 7th, or a day later, the pig was treated for 2½ hours under like conditions, at the end of which time the pig had a convulsion. It appeared to be totally exhausted, and died during the night. Autopsy showed no gross changes. No microscopical studies were made because it could be assumed from the excessive doses given that changes in the tissues would have taken place, for this was an extreme test, and the radiation was approximately 1,000 to 1,500 times as much as would be given to a patient when one considers the relative size of the patient and the guinea pig.

Pig No. 3 was placed in a box receiving gases pumped from about the tube. The object of this test was to determine whether there was any difference between the gases coming from about the tube and those taken from the case of the transformer, as was done with Pig No. 1. Neither Pig No. 1 nor No. 3 received any roentgen ray radiation. After the first two hours of inhalation of this gas, the pig seemed to be weak and inactive. In fact, the pig seemed to be unable to stand up and was panting irregularly, and seemed to be sick. The temperature of the air in the box was 103° Fahrenheit. On the next morning the pig seemed to have recovered. After inhaling this gas again for two hours, symptoms developed similar to those of the day previous and when the pig was placed in the box for feeding with the other pigs, it crawled into a corner and refused to eat. The pig then received no treatment for three days. On the sixth day the pig was again placed in the box for four hours. At the end of this time it was found to be dead. Autopsy showed no gross pathology.

From these tests we learn what we have known before, *First*, that guinea pigs, as well as other small animals, can be killed by excessive doses of the roentgen rays. *Second*, it would seem that the gases from about the tube are more poisonous than the gases from the corona in the high tension case. I realize that the experimental evidence, as well as the clinical observations, is not conclusive.

The fact that the guinea pig died from excessive radiation might lead a superficial observer to conclude that the radiation is the cause of the symptoms, but it would not explain the sickness that develops in some patients even from a single dose of rays, nor the fact that the friend of a patient sitting in the same room became nauseated while that particular patient did not even show any symptoms. In the case of one patient whom I was treating for uterine fibroids, the patient became sick after each treatment, no matter how small the dose. We had divided the course of treatment into small portions so that she received only two or three doses in one day, and had an interval of one or more days between treatments. Finally she requested that she be given all of her treatment on one day so that she need only be sick once. This was against my judgment, but the patient insisted upon it, and to my surprise, and to her surprise, she developed no nausea and no constitutional symptoms. This patient received 10 doses on one day. One would think that whether constitutional symp-

toms are the direct result of the rays, or whether they are due to the gases, that the smaller the dose and the greater the interval between these doses, the less effect on the constitution, and yet this observation on a patient who seemed especially sensitive and who showed no symptoms after an excessive course of treatment, would seem to contradict such view.

TREATMENT

The Relief of the Symptoms After They Have Developed.—For this I have found nothing that is really satisfactory. One patient seemed to get relief from small doses of strychnia taken by mouth, but many others seemed to obtain no benefit from this, and objected to the bitter taste. Therefore, that was abandoned. Some patients seem to get relief from aromatic spirits of ammonia, and for a time we allowed the patient to inhale aromatic spirits of ammonia during the treatments and afterwards, and we believe the patients got some relief. A few patients received almost immediate relief from the administration of aromatic spirits of ammonia in a glass of hot water. Others concluded that the aromatics only made them vomit. I believe, however, that the administration of aromatic spirits of ammonia in hot water has given more satisfaction than anything else. When there is much exhaustion, rest in bed, plenty of fresh air, with hot liquids, seem to do most good. When the patient is not much exhausted, walking in the fresh air seems to bring relief.

Prevention.—The real treatment of this condition is the prevention of the symptoms completely, and toward this end I believe that the more completely one can eliminate gases and provide absolutely pure, fresh air in large quantities, the more will these symptoms be reduced. Toward this end, in my original discussion of this subject in 1915, as you will remember, I had developed an inhalation cone which permitted the patient to take air from the outside of the building to which could be added pure oxygen. The patients objected to this so much that I have abandoned it, and instead have introduced suction fans which are claimed to change the air of the room once every half minute. This, of course, is only theoretical, and depends not only upon the suction power of the fan, but upon the amount of air that can be allowed to enter the room. During the summer months, when the air is warm, this can be accomplished by plenty of open window space, but during the winter months, when the air must be heated, such a free use of air is impossible. Therefore, it should be our duty to first eliminate, so far as is possible, all corona. This can be tested in a dark room, and I must admit that up to the present time I have not succeeded in eliminating this completely. We have placed around the terminals of the tube, at the suggestion of Mr. Snook, "spun brass" which eliminates the corona from these areas. We have used speaking tubes as far as the reels to eliminate any corona from the wires, but we have not eliminated the corona from the contact points, about the reels, nor have we eliminated entirely the corona from the wires leading from the reels to the tubes, though for this we are using heavy insulated wire. The reels may be encased. This will not prevent the corona, but will prevent the escape of gases.

To remove the corona from the high tension case, which we found contributed most to the odor of the room, we are using rotary suction pumps and carrying the gas entirely outside of the room. With these measures we are using blowing fans with the purpose of blowing the gases away from the patient's head and toward the suction fan. As a result of these measures we have reduced these constitutional symptoms to about one-third of the number that formerly occurred. In other words, roughly estimated, we count on constitutional symptoms in about one out of ten patients.

This paper is not conclusive, and is submitted for discussion, with the hope that some one else has found something better.

TECHNIQUE OF ROENTGEN EXAMINATION OF THE SPINE WITH ILLUSTRATIONS OF CERTAIN LESIONS*

BY THOMAS A. GROOVER, M.D.

WASHINGTON, D. C.

THE technique for the roentgen examination of the spine embodies many of the elementary principles common to the examination of other parts of the body. My own technique for spine examinations, so far as I know, possesses no new or original features, and but for the kindly solicitation of our president I would hesitate to make this presentation to a body of trained roentgenologists.

In the first place the making of a satisfactory roentgenogram of the spine is not nearly so difficult as some imagine. I do not mean to infer that brilliant plates can always be produced, but plates of good diagnostic quality can nearly always be obtained, both in the anteroposterior and lateral projections, regardless of the size of the patient. There are certain patients, usually of the fat and indolent class, who do not have enough lime in their backbones to cast very contrasty shadows, but mere size, although a handicap, is not necessarily an insurmountable obstacle to the production of roentgenograms of fair quality.

FIG. 1. FRACTURE-DISLOCATION OF TWELFTH DORSAL.

No paralysis. The fracture of the laminæ in this case evidently resulted in a spontaneous decompression. Patient died suddenly of pulmonary embolism ten days after accident.

In examinations of the spine below the level of the diaphragm it is desirable, whenever practicable, to have the gastrointestinal tract thoroughly empty, and the patient should be prepared just as for a kidney examination.

In posing the patient for the anteroposterior view care should be taken to have him be perfectly straight and symmetrical on the table, and the slightest rotation of the body should be avoided. It is possible to make any spine give the appearance of a scoliosis, with rotation of the vertebræ, by failing to observe this precaution. In examining the lumbar and lower dorsal spine I usually have the patient's knees flexed and an effort is made to obliterate the lumbar curve as much as possible.

In posing the patient for the lateral view the same precaution should be observed as to the rotation or torsion of the trunk. Sandbags should be used liberally in an effort to make the patient feel absolutely secure and steady. Failure to attend to these minor details often determines the success or failure of the entire procedure. As a general rule I prefer the straight lateral view to the oblique, although in the thoracic spine the latter will occasionally give the more information. I have often felt the need of some arrangement whereby the lateral exposure could be made without having to turn the patient on the side, as it is sometimes difficult, and unsafe as well, to turn a badly injured patient on the side, and is often

* Read before the American Roentgen Ray Society at the Eighteenth Annual Session, New York City, September, 1917.

very painful in carcinoma and other pathological conditions. So far I have been unable to think of any satisfactory or practical way out of the difficulty.

I would like here to stress the importance of the lateral view. I am sure we do not employ it enough. It is just as important to secure right angle views of the spine as of the leg or arm, and our diagnoses are as equally circumscribed by failure to do so.

sections on multiple plates. Somewhat better detail can, of course, be obtained by the use of smaller diaphragms, but I do not believe that it fully compensates for the loss in other respects.

I never employ a plate focus distance of less than twenty-four inches. Often it is twenty-eight or thirty inches, and in making the lateral views sometimes as much as three feet.

Compression is used in stout patients,

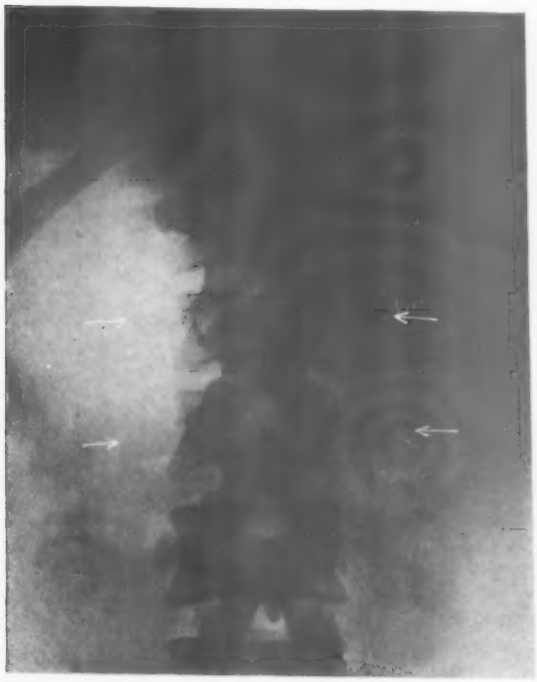

FIG. 2. COMPRESSION FRACTURE OF THE BODIES OF THE SECOND AND THIRD LUMBAR VERTEBRÆ.

There are six lumbar vertebræ, the sixth being partially sacralized.

FIG. 3. LATERAL VIEW OF FIGURE 2.

No paralysis. Recovery.

In suspected lesions of the upper cervical region a view should be made through the open mouth.

Stereoscopic plates should be the invariable rule in all spinal examinations. I use generally the 10 x 12 and 11 x 14 sizes, and occasionally the 14 x 17. Diagnoses are not infrequently missed by failure to examine a large enough area of the spine, and I think that it facilitates the interpretation to view a large area on one or two pairs of plates rather than small

but not as a rule in the medium or thin. A large rubber bladder—the inside of a hand-ball—is used for compression purposes. It is frequently placed beneath the cone, not for the purpose of compression, but as a supplementary filter. In making the lateral projection it helps to steady the patient.

I rather prefer to do spinal work on a Cole table as by its use one can judge something of the illumination he is getting through, and regulate it accordingly.

I have for several years used the Coolidge

FIG. 4. COMPRESSION FRACTURE OF BODY OF ELEVENTH DORSAL.

No paralysis. Recovery. The prognosis in this type of injury is comparatively good.

tube exclusively in all of my work, indeed ever since they were first put on the market. I have heard it stated over and over again by the best men that they would not do good bone work. Perhaps they are right, but I am sure that the general average of my work has been better than it was previously with gas tubes. I have no doubt that the very critical observer will be able to pick out Coolidge defects in my plates, especially after he knows that they have been made with a Coolidge tube, but I have more than once been able to fool very keen observers who did not possess such knowledge, and I doubt exceedingly if anything of real diagnostic value has been lost by its employment.

I have not been able to notice much difference in plates made with a broad, medium, or fine focus. This can probably be explained by the fact that I uniformly employ a comparatively long plate-focus distance.

I use a constant setting of the rheostat for all bone work quite regardless of the

FIG. 5. COMPRESSION FRACTURE OF BODY OF SECOND LUMBAR.

No paralysis. Recovery.

FIG. 6. LATERAL VIEW OF FIGURE 5.

FIG. 7. FRACTURE-DISLOCATION OF SECOND LUMBAR.

The cauda equina begins usually at the level of the second lumbar.

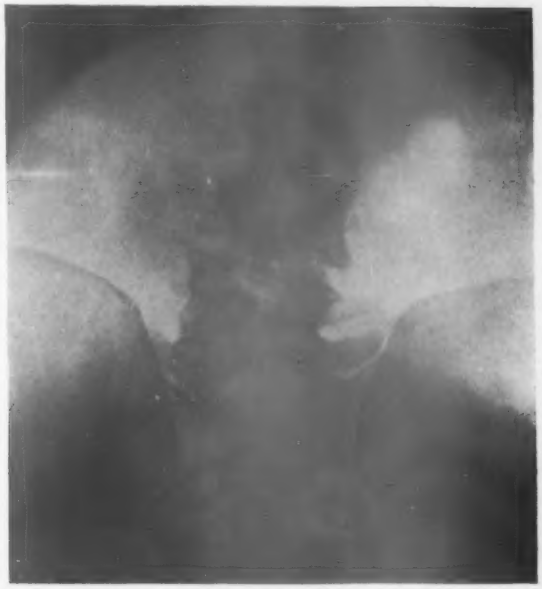

FIG. 8. DEFORMITY OF FOURTH AND FIFTH LUMBAR, THE RESULT OF AN OLD INJURY.

Low back pain, but good function. Note compensatory lateral curvature.

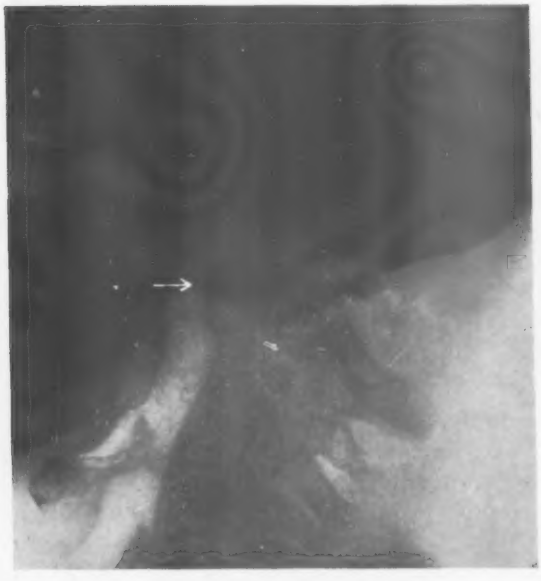

FIG. 9. FORWARD DISLOCATION OF ATLAS.

Recovery with a stiff, painful neck. No paralysis. Study of stereoscopic set of plates is always an advantage.

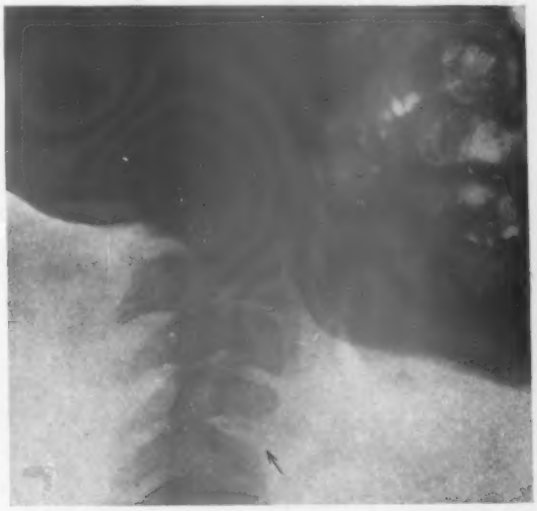

FIG. 10. PARTIAL FORWARD DISLOCATION OF THE FOURTH CERVICAL.

Recovery with a stiff, painful neck. No paralysis. Comparison with normal cases desirable.

FIG. 11. COMPLETE FORWARD DISLOCATION OF THIRD CERVICAL.

No paralysis immediately following injury, and injury not regarded as serious until paralysis began to develop and progress several days later. Death in two weeks following operation.

thickness of the part to be examined. The length of the parallel spark is determined with that particular setting of the rheostat. It must be actually and accurately measured. A constant setting of the rheostat

FIG. 12. FRACTURE OF TRANSVERSE PROCESSES OF SECOND, THIRD, AND FOURTH LUMBAR.

on the filament control will not suffice. I frequently test out the length of the parallel spark while the exposure is in progress, and always do so between the making of stereoscopic pairs where speed is not paramount.

Most of my failures to get fair results can be attributed to fluctuation either of the filament or high potential current. I have not tried the current stabilizer now coming into use, but feel that a perfectly stable current would eliminate my greatest source of failure.

In spine work I employ a spark length of from three to five inches, depending

FIG. 13. DESTRUCTIVE LESION OF THE UPPER LATERAL MARGIN OF THIRD LUMBAR WITH NARROWING OF CONTIGUOUS JOINT SLIT.

The lesion is believed to be tubercular.

upon the thickness of the patient. For the patient of average size a gap of four to four and a half inches is used, and a gap of five inches, which is never exceeded, is used only in the very stout, and occasionally for the lateral exposures. Much work is done with a back-up spark of only three and a half inches. A difference of an inch or even half an inch in potential as measured on the parallel gap may determine the worth or worthlessness of a plate.

I must confess to the very unscientific practice of never looking at my milliamperemeter. As a matter of fact with the rheostat setting employed, and with a back-up spark of four and a half inches, it registers about twenty-two milliamperes.

I must confess also that I guess at the time of my exposures which is doubtless a very bad habit. I give what I feel to be enough and let it go at that. As a matter of fact, merely for the purpose of embodying the figures in these notes, I found upon investigation that in making a single anteroposterior plate of the lumbar spine in a patient of medium size, I was giving an exposure of about sixteen seconds. In lateral views I give at least twice as long. Dr. Hickey at the meeting a year ago in Chicago when questioned as to the technique employed in his beautiful spine work, advised taking plenty of time in making the exposure. I can heartily concur in his advice. Speed in roentgenography is only necessary for the purpose of eliminating the blurring effects of motion, and is therefore not a prime requisite in the roentgenography of most of the skeleton.

The question naturally arises as to the danger of burns with the technique I have outlined. As to this I can state that I have heard indirectly of one instance where a mild erythema developed in one of my cases. In this case there had for some unknown reason been a marked drop in the tube resistance during the exposure, and the patient had received a rather large volume of rays of very low penetration. Trouble was not altogether unexpected in this case. A filter is used next to the diaphragm on the tube stand. Personally, after considerable experience I feel safe in using the technique described. Of course judgment must be exercised as to the repetition of exposures. Certainly if the danger were very great I would long since have been forced to abandon the technique.

FIG. 14. TUBERCULOSIS OF EIGHTH DORSAL WITH ABSCESS FORMATION, INDICATED BY THE FUSIFORM SHADOW SEEN THROUGH THAT OF THE HEART.

Without careful observation such a shadow might under certain circumstances be mistaken for an aneurysm.

FIG. 15. INCOMPLETE SPINA BIFIDA OF ELEVENTH AND TWELFTH DORSAL.

This possibility must always be kept in mind especially in children.

MYELOCYTIC LEUKEMIA

THE treatment of myelocytic leukemia by radium and roentgen rays is still more or less in the experimental stage and in view of the favorable results obtained by both methods in isolated cases, it becomes a matter of increasing importance to study and record more extensive series of cases. Such an opportunity was afforded at the 32nd Annual Meeting of the Association of American Physicians, when Giffin, of Rochester, Minn., Stengel, of Philadelphia, Peabody, of Cambridge, Mass., S. Solis Cohen, of Philadelphia, and others, contributed experiences on the subject.

According to the report contained in the *Medical Record* for July 7 Giffin treated thirty patients by direct application of radium element over the spleen, using 5 to 10 mgm. of radium in a tube for from three to four hours, with a total exposure of 24 to 36 hours, and this seemed to him the best treatment for this affection. Stengel had 42 records available of 50 patients treated with roentgen rays, and in many of these the clinical improvement was far out of proportion to that of the blood condition. More of the cases had eventually better results clinically than those cases in which the improvement in the blood picture was noted. Leucocytic leukemia, like pernicious anemia, seemed to be a relapsing disease.

Dr. Peabody confirmed the favorable radium results from his own experience, but he thought that these patients should return for examination once every week or once a month. Unless some such system of control was instituted, patients were apt to return only when the symptoms appeared again, the spleen was enlarged and the blood count was very great.

S. Solis Cohen, who has observed the results from both kinds of treatment, thought radium was more prompt in getting results without much constitutional reaction.

SPONDYLOLISTHESIS OR LUMBOSACRAL DISLOCATION*

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AS comparatively few cases of spondylolisthesis have been reported recently in medical literature, it must have been frequently overlooked, for unless thoroughly understood, such a dislocation in any part of the spine would not be realized or suspected without accompanying paralysis. A case which was evidently spondylolisthesis was reported by Herbiniaux in 1782, and is probably the first case on record. Very little notice was given to the condition until Killian, in 1853, took up the study of it seriously. Schlesier, up to 1892, collected 53 cases in skeletons and many more clinically. At the Hospital for the Ruptured and Crippled, within two years, the writer has examined five cases roentgenographically.

It is defined as "a forward and downward dislocation of the body of the last lumbar vertebra on the sacrum." Most authors agree that the fifth lumbar is most frequently subluxated. The name originated with Killian and is derived from the Greek spondylus (vertebra), and olisthesis (a slipping out or down).

This condition is one of extraordinary interest on account of the mildness of symptoms in most patients, where such a dislocation would be expected to seriously injure the nerves of the cauda equina. Various theories are advanced as to the eti-

*Read before Eighteenth Annual Meeting of the American Roentgenology Society, New York City, September, 1917.

ology, among which are tuberculosis of the spine (Killian), congenital anomalies (Braun, Swartz, Spaeth), fractures (Neugebauer), atrophy of the intervertebral cartilage (Rokitansky), injury other than fracture (Barnes, Lawrence). Chiari, in 1892, said that "the etiological factor furnishes the disposition only, from which the olisthesis may arise, but not necessarily so."

That it is said to be peculiar to women by obstetricians as in Edgar's "The Practice of Obstetrics," 1903, in which he gives violence as a main cause, is due to its importance as an obstruction to labor, but men, being more exposed to violence, should present the larger number of cases. The latter observation will no doubt be verified as the roentgen examination discloses the diagnosis, when others than obstetricians will have recognized and reported the condition.

Ralph Fitch,[1] in his paper showing a close study of his subject, makes the following statement: "No one can justly say that tuberculosis, fractures, congenital deformities, or any of the alleged causes may not produce spondylolithesis. A point which I wish to make is that none of these conditions is necessary for its production. The pathological conditions that may have been interpreted as tuberculosis, atrophy of cartilage, etc., may have been the result and not the cause of the condition." Goldthwait and others working with him have shown after an exhaustive study of the anatomy, that the structure of the lumbosacral articulations is subject to such predisposing variations as to render a spondylolisthesis very easily possible when undue strain is put upon them through violence or otherwise. Two types of spondylolisthesis have been reported; one, the unilateral type, in which the early symptoms of paralysis have been so pronounced as to render early diagnosis probable. Goldthwait studied the mechanics through which the condition is reached and in his well-known article on the subject [2] showed how easily a unilateral spondylolisthesis might be produced which, by compressing the cauda equina, caused paraplegia. He was so unfortunate as to bring about this condition while endeavoring to correct a

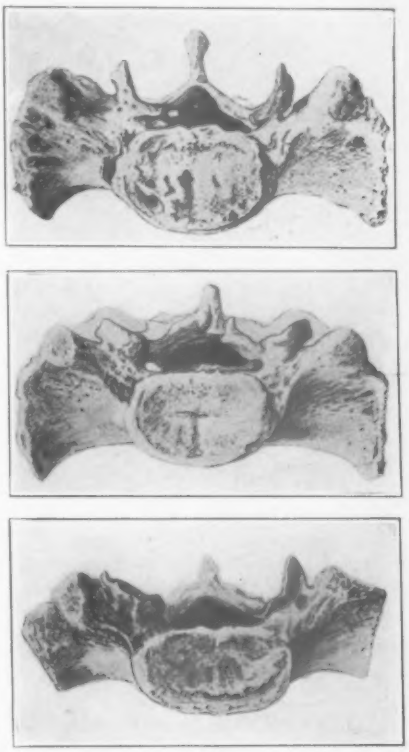

FIG. 1. COMMON TYPES OF LUMBOSACRAL ARTICULATIONS WHICH PRESENT ANATOMICAL PECULIARITIES. (GOLDTHWAIT.)

A. Shows sharply crescentric articulations. The lateral portions extend backwards almost at right angles articulating with the 5th lumbar process. This makes a very stable joint. B. Shows a flat articular surface with the axis nearly transverse. This provides a much less stable articulation than the preceding type. C. Shows both types in the same individual thus favoring the unilateral type of dislocation.

sacro-iliac dislocation. He notes, on the other hand, the gradual development and mildness of symptoms where the displacement is bilateral.

The majority of cases, believed to be the bilateral type, have been those in which the onset has been of so mild a character as to cause little disability, and gradually develop more definite symptoms.

[1] *Am. Jour. Orthop. Surg.*, May, 1913.
[2] *Boston Med. & Surg. Jour.*, March 16, 1911.

The backs of these patients present a characteristic posture, described by Dr. Royal Whitman in his book, "Orthopedic Surgery," as follows: "The trunk is displaced forward and downward in its relation to the pelvis. Thus the inclination of the pelvis is lessened or lost, and the lumbar lordosis is absolutely or relatively increased. The sacrum projects and the space between the ribs and the iliac crests is diminished." I wish, in this paper, to emphasize the value of the roentgen ray as a means of proving out the diagnosis. The accompanying reproductions of the roentgenograms, made stereoscopically, show

FIG. 2. DIAGRAMMATIC LATERAL VIEW OF THE SACRUM. (GOLDTHWAIT.)

Shows intermediate stage of dislocation with the articular processes resting on the body of the sacrum thus leaving space for the cauda equina.

FIG. 3. POSTERIOR VIEW OF FIG. 2. (GOLDTHWAIT.)

Shows the wide space left beneath the arch for the cauda equina.

FIG. 4. DIAGRAMMATIC LATERAL VIEW OF THE SACRUM. (GOLDTHWAIT.)

This shows that even in a complete stage of dislocation the posterior articulations still resting on the body of the sacrum leaves a space for the cauda equina.

FIG. 5. POSTERIOR VIEW OF FIG. 4. (GOLDTHWAIT.)

Shows sufficient space for the passage of the cauda equina between the arch of the 5th lumbar and the body of the sacrum.

the condition plainly. In view of this fact, it would seem the correct method of procedure to lose as little time as possible between the time of the patient's earliest symptoms and the making of the first roentgen examination showing the actual structural relations. This may be followed by other plates at intervals, if symptoms indicate, so that increased displacement may

FIG. 6. DIAGRAMMATIC VIEW OF THE LUMBOSACRAL REGION. (GOLDTHWAIT.)

Shows a unilateral right-sided dislocation of the first degree.

be carefully noted, and effective measures taken to check it by means of braces, belts or Albee bone-inlay operations bridging across the spinous processes involved.

To get the mechanics of the condition clearly before your mind, there is no clearer description than Goldthwait's. "The lumbosacral joint is capable of considerable motion, fully one half of the motion of the trunk below the lower dorsal region being made in this articulation and the one just above it, the remainder of the motion being distributed between the rest of the lumbar spine and the sacro-iliac joints. In forward bending, since the bodies of the vertebræ are so large, the motion at the lumbosacral joint is made partly by the changes in the intervertebral disk, but chiefly by the articular processes of the fifth lumbar vertebra sliding upward upon the opposing processes on the sacrum (Fig. 1). Naturally, if the motion is carried too far, the articular processes will be separated (posteriorly) and the vertebra can then slip forward upon the sacrum. If this is continued, the last lumbar vertebra may slip entirely off the vertebral articulation of the sacrum (as is shown in Figs. 2, 3, 4 and 5) and a true dislocation or spondylolisthesis results. In such a displacement, since the articular processes of the fifth lumbar extend below the lower surface of the body of the bone, the body of the fifth is raised so much above the superior surface of the sacrum that there is practically always a space for the cauda equina—this, together with the fact that the change takes place slowly, makes gradual readjustment possible and explains the fact that paralysis under such conditions does not result.

"If, now, the displacement of the fifth lumbar or the separation of the articular processes takes place only upon one side, a much more serious condition at once results. The displaced articulation slides forward and to the outside (Figs. 6 and 7), with the result that the whole spine with the body of the fifth lumbar vertebra

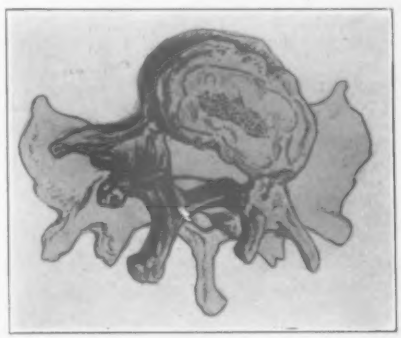

FIG. 7. DIAGRAMMATIC VIEW OF A UNILATERAL DISLOCATION. (GOLDTHWAIT.)

Shows the dislocated articulation on one side only, sliding forward on this side, the other side holding. The entire cauda equina is compressed causing partial or complete paralysis below.

is rotated forward on the side of the displacement (Figs. 6 and 7). With this rotation and with the moving forward of the

FIG. 8. ANOTHER FACTOR WHICH WOULD PRODUCE GRADUAL PARALYSIS.

Diagrammatic representation of the projection of the intervertebral disk into the canal (Goldthwait). In this position the posterior portion is separated.

displaced articular process, the other process is drawn nearer to the center of the body (Figs. 6 and 7), at the same time necessarily being drawn forward with the result that the spinal canal is narrowed (Fig. 7), and the narrowing may be so marked that the entire cauda equina is compressed, with paralysis, either complete or partial, below this point. Another element, the intervertebral disk, which was not at first appreciated, but which is undoubtedly of much importance as a direct cause of the paralysis, consists in the separation and possible displacement of the intervertebral disk, lying between the body of the vertebra and the sacrum. Because of the structure of the disk, if such separation occurred, the projection of the disk and the possible paralysis would be gradual in development, since the dense annular portion must be stretched by the central portion and would require some hours or possibly days for the full extent of the displacement to develop.

"The projection of the disk into the canal when the posterior part is separated, is shown in Fig. 8."

(1) In the roentgen stereoscopic examination, the following details are to be carefully noted: spine as a whole; five lumbar vertebræ, whether of normal shape, in proper order above the sacrum, each body normal, with a space for the inter-

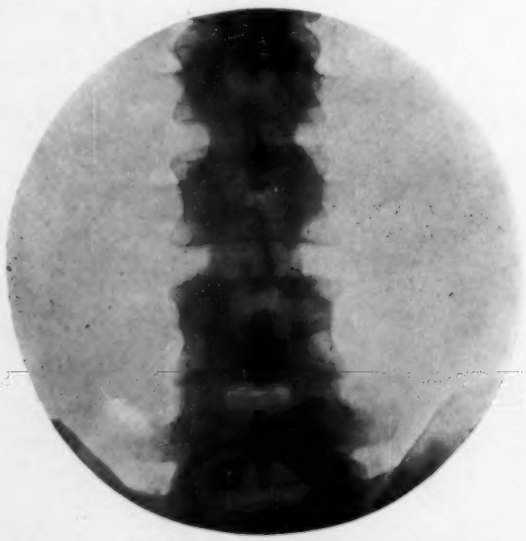

FIG. 9. ROENTGENOGRAM OF NORMAL SPINE.

Shows the usual appearance from 2nd lumbar to the upper border of the sacrum. Note the clear space for the intervertebral disk between each body.

FIG. 10. ROENTGENOGRAM OF NORMAL SPINE (LUMBOSACRAL REGION).

Shows the 5th lumbar as a whole (its body and transverse processes) well above the body of the sacrum, the intervertebral disk showing clearly between.

vertebral disk; fifth lumbar as a whole, its position and the relation of its body and transverse processes, whether clearly above the sacrum or overlapping its upper border (Figs. 9 and 10). Note the spinal foramen, lamina and spinous process; posterior facets, whether fractured or not; finally the degree of dislocation.

(2) In differential diagnosis of spondylolisthesis, uncomplicated, there is no evidence of present or past bone disease. A compression fracture higher up involving the upper lumbar vertebrae is usually evident. The age of the patient at the time of the injury is indicated, for in recent cases the fourth and fifth vertebrae and transverse processes are not stunted but are similar in size and shape to those above; or the fourth vertebra and transverse processes are rudimentary and underdeveloped, relatively proportional to the age at which the dislocation occurred. In no case was a definite fracture of pedicle, lamina or facet made out.

The following five cases which have come under my observation are based on the clinical diagnosis made by the staff of the Ruptured and Crippled Hospital from the roentgen diagnosis and corresponding clinical symptoms and physical examinations. All are apparently those of bilateral spondylolitheses. One is of early childhood or congenital in a female now 15 years old; one is in a male, taking place at the age of 9 years, not diagnosed until 27 years later; three are recent cases in adults, two males and one female.

Case I. Hospital for the Ruptured and Crippled Service of Dr. Royal Whitman, under the care of Dr. Armitage Whitman.

T. M., Age 15, Female.—The patient seemed all right up to 11 years, but until 13 she sat in the house a good deal. At 12 years she only complained of a pain in the calves of her legs. She was not as active as other children, could not walk as well and complained. Her condition did not improve and at 13 years she began to have pains in her back any time during the day, particularly when she was asked to do something. At this time her mother noticed a lump in her back. Her physician said "it was nothing," but her mother watched the lump and found it became more pointed. From 13 to 16 years she grew steadily worse, would walk a block and come home crying with pain. The patient has been better since wearing a brace.

Fig. 11. Case I, T. M., Age 15.

Shows moderately the characteristics of lumbar lordosis with the free ribs low over the crests of the ilia and a prominent sacrum with depression above.

Physical.—Body in standing is inclined forward above the sacrum, and the spinous process at the lower extremity of incurvation is very prominent, evidently marked displacement forward of vertebra above this point (Fig. 11).

Roentgen Examination.—Examination shows only three normal lumbar vertebrae. The fourth is seen clearly, but has rudimentary transverse processes (Fig. 12).

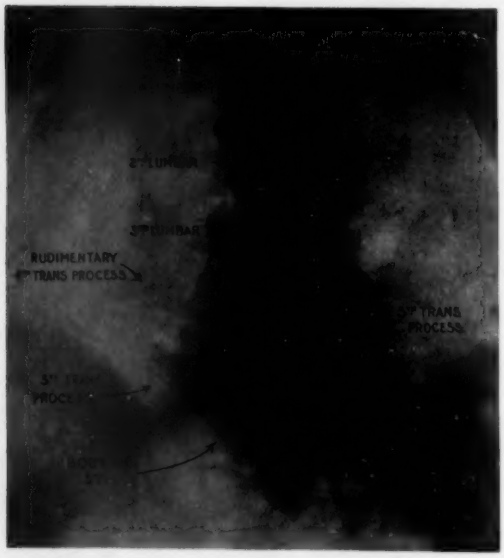

FIG. 12. CASE I, T. M.—COMPLETE SPONDYLOLISTHESIS.

Note the first three lumbar vertebræ are normal. The fourth is obscured by the fifth which is dislocated forward and downward until its upper aspect faces directly forward. The prominent body of the 5th and the transverse processes are well below the upper border of the sacrum.

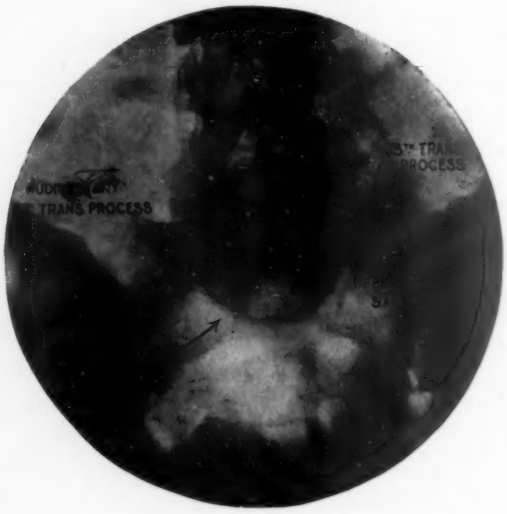

FIG. 13. CASE I, T. M., AGE 15. (Compare with Figs. 4 and 5.)

A clearer plate of the lumbosacral region confirming Fig. 12. The rudimentary appearance of the 4th lumbar especially its transverse process, failing any recent history, suggests that the original dislocation was congenital or of early childhood.

This vertebra seems to articulate with the sacrum. The fifth lumbar is dislocated forward and downward on the sacrum until its entire upper aspect, including that of the lamina and spinous processes, faces directly forward (Fig. 13). The posterior articular facets of the sacrum seem to be underdeveloped. As the history gives no evidence of injury, the whole condition would seem to be that of early childhood or even congenital. The lateral view (too indistinct for reproduction) shows faintly the wedge-shaped body of the sacrum. In front of the upper part of the sacrum, the dislocated body of the fifth lumbar faces forward and upward. The fourth lumbar is apparently articulating with the sacrum. The bodies of the fourth, third, second and first lumbars are in their usual position. It is therefore evident what a tortuous course the cauda equina must take in passing from the lower part of the fourth directly forward beneath the arch and spine of the fifth lumbar, and then backward over the upper surface of the body of the sacrum.

CASE II. PATIENT OF DR. B. H. WHITBECK.

E. H., AGE 35, FEMALE.—Patient fell while getting off a street car. The car had stopped but started again, throwing her suddenly on her back. She walked home, then began to have severe pain in her back, and went to bed for a day or so. No nervous symptoms except a numbness which cleared up after a week.

Physical.—Three weeks after injury, examination showed considerable deformity. Patient was bent forward, leaning to the left side. No wrinkles were visible in the flanks. The most comfortable position was with the trunk flexed, with legs doubled under her. Her back was strapped at this time, and brace applied, which gradually helped her, straightening her up somewhat. Pain down the back and legs continued, which was more or less subjective. There was no disturbance in the knee jerk.

Roentgen Examination. — Examination showed to a moderate degree, stereoscop-

ically, an abnormal amount of angulation between the lower lumbar spine and sacrum, with a forward dislocation of the

FIG. 14. CASE II, E. H., AGE 35, FEMALE. (Compare with Fig. 6.)

Roentgenogram shows moderate dislocation suggesting the unilateral type. The body overlaps the upper border of the sacrum. The transverse processes are low, the one on the right overlapping slightly the border of the sacrum. The foramen seems to be viewed from above.

fifth lumbar on the sacrum. The body and transverse processes of the fifth lumbar are slightly below the level of the sacrum (Fig. 14). The spinal foramen with the upper aspect of the body of the lamina and spinous process are more in evidence than normal, and face forward.

Diagnosis.—A moderate amount of spondylolithesis with possible sacro-iliac dislocation on the left.

Within a year after the date of the injury, and after her suit had been settled, the patient had straightened up and resumed her normal position, and up to date, there has been no recurrence of symptoms.

CASE III. SERVICE OF DR. ROYAL WHITMAN, CARE OF DR. ARMITAGE WHITMAN.

H. C., AGE 38, MALE, WEIGHT 230 LBS.—MOTORMAN.—*Previous History.*—At nine years of age, the patient was butted in the small of the back by another boy's head. He felt faint at the time and laid down for a few minutes. The patient states that he had no severe symptoms for 24 years. But he always has had a pain of some character in the leg and back, but never a pain elsewhere of any consequence. Pain prevented him from concentrating his mind as a student. For the past two years he has had

FIG. 15. CASE III, H. C., AGE 38, WEIGHT 230 POUNDS.

Patient was "butted" in the back at the age of 9. Shows the characteristic lordosis in the stout man, short-waisted effect, with wrinkles in the lumbar region. Prominent sacrum with depression just above.

numbness in the right foot and leg up to above the hip, following short walks; he has had no "weakness" in back, but pain in lumbosacral region, which is worse in the morning when beginning to walk.

Physical Examination.—The examination showed the characteristic posture of spondylolithesis in a heavy man weighing 230 lbs. (Fig. 15).

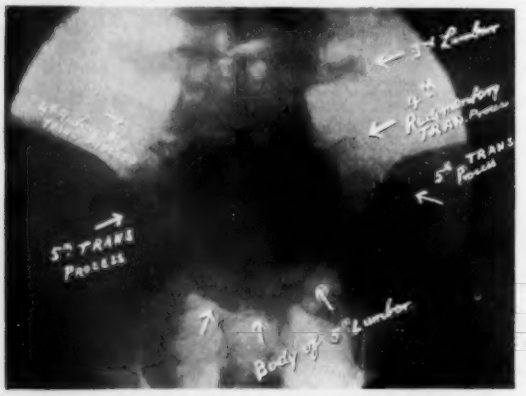

FIG. 16. CASE III, H. C., AGE 38. (Compare with Figs. 4 and 5.)

The 3rd lumbar is well formed as were the other two above. The 4th is somewhat obscured, its transverse processes are clearly rudimentary. The body of the 5th is completely dislocated forward and downward in front of the sacrum, its transverse process well below the upper border.

Roengten Examination. — Examination showed three well-formed lumbar vertebræ in lumbar region, the fourth rudimentary (as shown by the rudimentary transverse processes) and the body of the fifth dislocated forward in front of the sacrum, with its upper surface and spinal foramen facing forward and upward. The first, second and third vertebræ appear to be small bones for a man of his stature, but are fully developed, as compared with the rudimentary fourth. This undevelopment would seem to fix the date of origin as stated (Fig. 16).

CASE IV. SERVICE OF DR. CHARLTON WALLACE, CARE OF DR. W. L. SNEED.

J. J., MALE, AGE 45 (Fig. 17).—This case well illustrates the misleading sensations at the time of injury and the insidious development of disability and nerve pressure symptoms in a few months or even years. This freedom from pain and lack of symptoms cannot be overemphasized, for in medico-legal cases the absence of symptoms at the time of the injury which would tend to prove the diagnosis prevents the recovery

FIG. 17. CASE IV, J. J. M., AGE 45.

Shows complete spondylolisthesis of recent origin. Characteristics of lumbosacral dislocation are unusually well shown, posture, lordosis, short-waisted effect, wrinkles in the flanks; sacrum is prominent with depression just above. There is noticeable atrophy of the right thigh muscles and calf of the leg.

of damages in proportion to the actual injuries received.

As the patient's description is one of unusual intelligence and shows accurate observation, I give his own words. His testimony from a medico-legal standpoint is peculiarly interesting since his truthfulness and accuracy almost proved his undoing in his trial for damages before a jury who were confused by the absence of symptoms at the time of injury and could not seem to realize that they developed later.

"I am 45 years old and a railway mail clerk. Three months ago in a collision where a motor hit my car a terrific blow I happened to be bending over with my back toward the motor and as I was bent down to the floor with my buttock against the cross table and my left hip wedged in the angle formed by the side table I received a severe shock and concussion, as my body would not give with the impact of the motor. In order to save striking my head against the sharp edges of the letter case at the same moment I swung around sharply. With the concussion I had the feeling as if something gave way in the region between my hips, but I felt no pain there and dismissed it from my mind until called to account for the condition in which my spine was found when examined by different physicians. I believed that severe injury must be accompanied by severe pain and gave no thought to this occurrence, attributing this feeling of dizziness from which I suffered to fright.

FIG. 19. CASE IV, J. J. M., AGE 45. (Compare with Figs. 4 and 5.)

Shows four normal vertebræ in proper order. The 5th is displaced forward and downward, the body showing clearly below the upper border of the sacrum, its upper aspect faces forward. The transverse processes are very low.

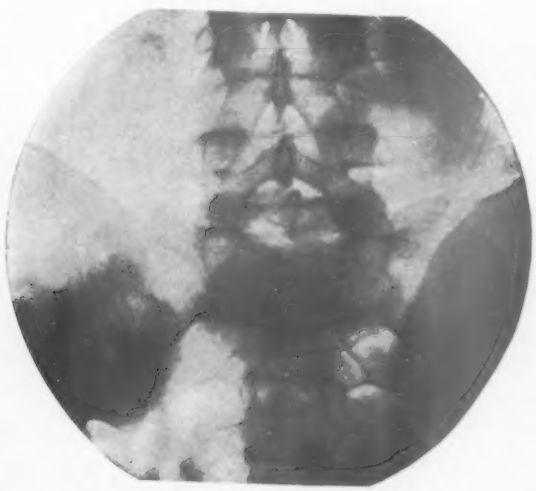

FIG. 18. CASE IV, J. J. M., AGE 45.

Lumbosacral region showing details of condition indicated in Fig. 19.

"After a six-day lay-off at home I returned to work, and as the work was light I suffered but little inconvenience. Two weeks after the accident while shaving myself one morning my leg became somewhat numb, this feeling extending down to the calf (left leg). This feeling of numbness recurred in the street the same day. This numbness was repeated so frequently and so severely that the following week I reported for examination, which was a superficial one, made without the removal of my clothing or underclothes. The diagnosis of 'contusion of the hip' was made, but as the condition continued without relief, I went to my own surgeon who

made the diagnosis of 'inflammation of the sciatic nerve'; but he made no examination of the spine. At this time I was unable to bend over without a good deal of difficulty. I continued my work for two and a half months, during which time I was taking electric massages, etc. When I became convinced that I had some severer injury than a bruised sciatic nerve, I went to the railway surgeon for an examination. He diagnosed my case as 'slight strain of the spine' and advised me to lay off, and obtain leave of absence for 30 days.

"Whether or not my spine was dislocated to the extent that it now is, I am unable to say. I do know though that not one man in a thousand would have kept at work as I did were they in the similar condition. *Time and again I was obliged to sit down, but I found that by twisting my body at the hips I could relieve what appeared to be a pressure on the sciatic nerve, and then get up and walk again.* By continuing on my run, subject to the sudden jerks of the car and the lifting incident to my position, I no doubt exaggerated my injuries, and if there is any condition that might be considered 'postural,' it has come from the injury received in March, and is not of prior origin."

Stereoscopic Roentgen Examination.—The first roentgen examination was made by Dr. Austin L. Hobbs. This and my own subsequent examinations showed that the spinous processes of the lower lumbar vertebrae and sacrum were not in line (Fig. 18). There was a marked angulation between the fourth and fifth lumbar vertebræ and the sacrum. The fifth lumbar was dislocated downward and tilted forward on the sacrum until its whole upper aspect, showing the body, transverse processes, spinal foramen, lamina and spinous processes, faced directly forward and only slightly upward. The transverse processes of the fifth lumbar were plainly much lower than their usual position. On the left the transverse process was well below the uppermost border of the body of the sacrum.

The plane of the fourth lumbar was shown to be well forward, but its lower articulating surface was on a level with the posterior facets of the sacrum, and occupied the usual position of the fifth (Fig. 19).

There was no evidence of old disease.

The uniformly normal development of all the transverse processes and of all the lower lumbar vertebræ was such that the

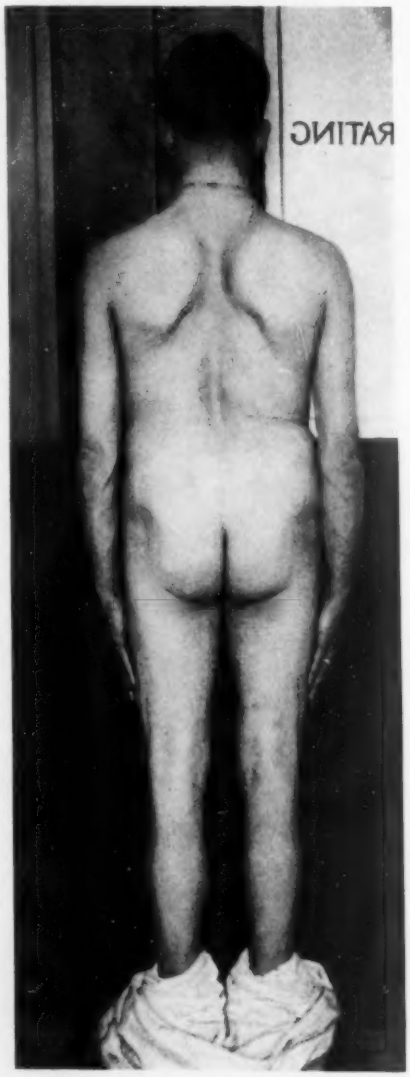

FIG. 20. CASE V, O. W., AGE 26.

Injury occurred 10 years previous. Shows lordosis, short-waisted effect, prominent sacrum with depression just above. Note that deformity is less marked in this case due to constant supervision with medical treatment when needed during a period of ten years.

condition could not have been congenital or of early childhood, but only after their full adult development.

Case V. Patient of Dr. Virgil P. Gibney

The history and treatment of this case extended over a period of ten years. Dr. Gibney then made the diagnosis of spondylolisthesis which was confirmed by roentgen examination ten years later.

Physical Examination.—This shows the characteristic posture of spondylolisthesis.

Roentgen Examination.—This shows definite dislocation of the whole of the fifth lumbar, forward and downward on the sacrum (Fig. 21).

Dr. Gibney's clinical notes covering the period of ten years show the favorable results which may be expected from proper medical treatment.

February 27th, 1907

O. W., Age 17 Years; Male (Fig. 20).—Eight months ago while jumping, he felt a snap in lower part of back and had some pain, but this seemed to trouble him very little until last October. Since then it has been getting worse, pain running down left thigh. At first it pained at night only on walking.

The patient found it very difficult to lie on his back and extend his limbs; he could flex perfectly when hips were sharply flexed, lordosis was overcome and he was free from pain; both sacro-iliac joints were prominent. Tenderness was noted over the sacrum; sensitiveness over lumbosacral region; extreme lordosis and sensitiveness (Fig. 20) along the course of the sciatic nerve.

March 1st, 1907

A solid plaster-of-Paris jacket was applied in the swing with as much extension being made as possible.

June 25th, 1907

Parts were still slightly sensitive over the sacrum and sacro-iliac joint; lordosis was not so marked.

Patient was very comfortable all summer.

January 7th, 1908

The patient had no pain now, but was a little lame and favored the left limb; lumbar lordosis was much increased and lumbosacral kyphosis marked; bore most of weight on right limb as he stood, but two sides of pelvis were about equal. When lying on back the patient preferred to keep left thigh flexed, but could make all movements fully; adductors on right side presented a little more fullness than on left, but both were tense; limbs were equal in length.

Fig. 21. Case V, O. W., Age 26.

Shows four normal lumbar vertebrae with the 5th dislocated downward and forward as diagrammed in Figs. 4 and 5.

May 9, 1911

The patient had been employed at clerical work for the last seven years. For the last ten days he had complained of pain in right leg; had grown to be a good height; still had sharp lordosis, but as he had grown so much, it was impossible to compare tracings, so these were not recorded. His free ribs hung over the ilium a little, and there was a transverse crease running

from one ilium to the other at the line of the umbilicus. The lower limbs were well developed; hip functions were perfect, but if the left thigh, for instance, was flexed rather sharply, he felt pain in the right thigh. Up to ten days prior to the above date he was perfectly well. Plaster jacket was advised.

May 29, 1913

The patient had a little discomfort with the jacket for a few days but since that time had worn the jacket well and had gotten entire relief from the pelvic and hip symptoms.

January 6, 1915

The patient began to complain again on the day preceding, for some unknown cause. He had sagged down again, so I suspended him and put him in plaster.

December 12, 1916

For the past two weeks he had been complaining again of pain; was to have another jacket.

Summary

1.—Violence is the direct cause of spondylolithesis although certain anatomical variations may favor the establishment of the condition. Fracture of the articular processes, though possible, cannot be proven.

Disease, if ever present, is an independent factor. The dislocation may occur in early childhood or even before birth.

2.—I emphasize the gradual onset of symptoms. The symptoms at the time of the injury may be so mild as to be ignored by the patient, and as the condition is rare the diagnosis in no case was made until months or years later when pain and paralysis and incapacity demanded attention and diagnosis.

3.—In medico-legal cases the jury is confused by the apparent absence of sensations and paralysis at the time of the injury, when so great a dislocation of the spine is claimed by the medical testimony for the patient.

4.—The prognosis is good with medical attention and support when indicated as symptoms develop, but a cure or replacement has never been reported.

5.—The condition is not uncommon and should always be considered in injuries of the lower spine. When stripped the patient shows the characteristic posture.

6.—The *x*-ray diagnosis must show only four whole lumbar vertebræ above the upper border of the sacrum. The fifth must not only overlap the upper part of the sacrum but the body must be well below and in front of the sacrum with the transverse process showing below the upper border of the sacrum, or, at least, much lower than their usual position. The upper aspect of the vertebræ as a whole should face forward presenting the picture of this surface of the body, the lamina and the spine foramen. The ray should be centered directly over this region and not higher. The back of the patient should be flattened on the plate, thighs flexed. Stereoscopic plates have an added value in showing forward displacement and the lateral view, difficult and often unattainable, if clear is of great value.

7.—Mistakes in *x*-ray diagnosis and technique can be made where there is a marked lumbosacral lordosis and the ray is directed obliquely from above downward on too large a plate. The plates should show good detail.

DISCUSSION ON THE PAPERS OF DR. GROOVER AND DR. DARLING

DR. ARIAL W. GEORGE, Boston, Mass. —At the January, 1917, meeting of the Society at Atlantic City, I presented what I considered several new observations on the changes which take place about the fifth lumbar vertebra, when this body is dislocated forward (spondylolisthesis). My attention was first called to this condition previously by Dr. Darling. Since that time I have tried to work out one or two diagnostic signs which can be made, with or without stereoscopic plates, on the anteroposterior view of the fifth lumbar vertebra; and in the lantern slides which I am about to show, I shall try to demonstrate these signs. Aside from the anteroposterior view, either singly or stereoscopically, it is absolutely essential that one make a lateral view of this area. Contrary perhaps to what Dr. Groover has just said, I believe that the lateral view of the sacrum, at least for purposes of diagnosis, is a great deal more simple than we have hitherto thought, and is as easy and almost as satisfactory as a lateral view of the dorsal region, especially if one uses an intensifying screen.

One important fact in the technique of the lateral view is that the greater the distance the tube is from the plate, at the same time using a small diaphragm, the better and sharper the detail of the lateral view.

In the anteroposterior view I have noted that when the transverse process laps over the sacrum (see Fig. 1) this is indicative of one of two things (I am not now speaking of the sacralized transverse process, but of the average normal in size and shape), either that the fifth lumbar is slipped forward upon the sacrum to an appreciable degree, or that there is a greater angle between the fifth lumbar vertebra and the sacrum. (See Fig. 3.)

One other effect in the anteroposterior view, which is consistent with the above, is a change in the angle of the lamina and of the spinous process. (See Fig. 1.)

In a study of the lateral view, aside from the actual slipping forward of the fifth on the sacrum, I believe the most important consideration is the acute angle

FIG. 1.

1. Shows the inferior portion of the fifth lumbar vertebra. 2. The change in angle and position of the spinous process as compared with the fourth. Note difference between the third and fourth. 3. Overlapping of the fifth right transverse process on the sacrum (a unilateral case). 4. Change in the angle of the lamina.

of the neural canal (see Fig. 3), and I have been of the opinion that symptoms arise from this latter fact rather than from any special disturbance of the forward displacement of the fifth. What gives rise to symptoms in a traumatically displaced sacrum is simply that the angle is too acute, and the same chain of symptoms appear as when the body is actually forward.

In our series of approximately thirteen cases, the problem arises whether this

FIG. 2. SHOWS FORWARD DISPLACEMENT OF THE FIFTH ON THE SACRUM.

Note the acute angle of the neural canal.

displacement forward of the body of the sacrum occurs spontaneously at the time of the injury or whether it is a developmental condition later.

I have been of the opinion that most changes, such as increased bone density, etc., which appear in and about the inferior portion of the fifth lumbar, associated with displacement, represent a progressive condition. This process goes on to a certain point, when by the increasing bone density, the body becomes anchored.

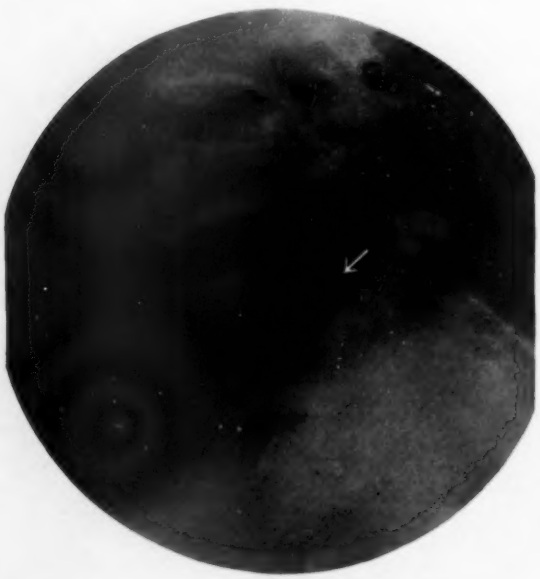

FIG. 3. SHOWS NO DISPLACEMENT OF THE FIFTH.

A very marked angulation of the sacrum in its relation to the normal and to the fifth vetebra is indicated.

Mr. H. W. DACHTLER, Toledo, Ohio.—I would like to ask Dr. Groover if he has had any experience in making a differential diagnosis between an old tuberculosis of the spine and a compression fracture of a vertebra. I have had a case in which the patient claimed to have been injured when an automobile body was allowed to slip upon his shoulders but he gave a history suggesting an old tuberculosis of the spine. There was a marked lesion present and I expressed the opinion that it was an old tuberculosis because the edges of the body, in a lateral view, were not smooth but were roughened and showed erosion. In all of my compression fractures the edges of the bodies have been smooth and the intervertebral space well defined. This is not the case in tuberculosis.

I would like to ask his experience in such cases.

DR. KENNON DUNHAM, Cincinnati, Ohio.—I wish to ask two questions. First, what does Dr. Groover consider the normal comparative size of the transverse processes of the third and fourth lumbar vertebrae? Second, I would like the doctor to make clear for me the differences between his method of taking and reading lumbar plates, which he has just described, and the previous work of Dr. Hickey.

These questions are in no way a criticism of this most valuable work of Dr. Groover. I am sure that the work is real and the report valuable, but I am anxious to find out if this is an addition to, a confirmation of, or a refutation of, the previous work of Dr. Hickey.

DR. E. H. SKINNER, Kansas City.—We find a great many spinae bifidae and other

transitional and congenital defects at the lumbosacral junction. It is very interesting in any study of these cases of changes at the lumbosacral junction, to be able to have a picture of your entire lumbosacral spine, because in cases in which you have the sacralization of your fifth lumbar vertebra you will almost invariably find a rudimentary twelfth rib. One can have a vertebralization of the first sacral segment or a sacralization of the fifth lumbar segment, so it is best to have your entire spine to count. One will find, in looking over a number of plates of the genito-urinary tract, sacralization of the fifth lumbar vertebra. The spina bifida occulta is another very frequent finding and probably should be noted, but not emphasized. We find it so frequently that it seems to be an old story; but we have known of medico-legal cases where such congenital defects have been misinterpreted, and made to imply a bony injury, whereas a spina bifida occulta is congenital and of little moment.

Dr. Thomas A. Groover, Washington, D. C.—I have had just the difficulty that Dr. Dachtler mentions. I don't think we are likely to have that difficulty if we see the patient immediately after the accident; but if he comes under observation some time later, it may be difficult to decide, and the clinical history will have to be relied upon in making the differential diagnosis. It might present a very perplexing medico-legal problem.

Dr. Byron C. Darling, New York, N. Y.—Just a few words on the size of the transverse processes of the fourth lumbar. If any of you remember to observe this from time to time, you will find that from above downward they become larger to the fourth; then the fourth, for some reason or other, often in what seem to be normal spines, is smaller; so that this observation of mine, about telling the date of the injury by the size of the stunted transverse processes, must be taken with a certain allowance.

Superiority of Roentgen Therapy in Mycosis Fungoides

At a meeting of the New York Academy of Medicine on March 2, 1917, Dr. Arthur F. Holding presented a patient who had been ill for nine years whose disease in the pre-tumor stage had been variously diagnosed by dermatologists of international repute as eczema, psoriasis or syphilis, and treated accordingly without results. The case then progressed to the tumor stage. We abstract the following, from Dr. Holding's report in the *Medical Record*, August 4, 1917 (p. 215).

The tumor formation was very extensive over the forehead, eyelids, cheeks, and back of the neck. Being so extensive, various methods of treatment were applied over areas of the lesion: Excision and skin grafting on the right forehead; roentgen rays on the left forehead; radium on the cheeks and fulguration for the eyelids. The results of excision and skin grafting were good at first, but later the flap broke down and sloughed, exposing the skull. The results of the roentgen rays and radium were clinically and cosmetically much better than those of attempted surgical treatment, and in the fulgurated areas the disease recurred. All of the lesions, however, disappeared within three months after the treatment was instituted. Two months later the patient returned with a general erythematous eruption over the entire body and it was decided to treat the recurrent areas with radium and roentgen rays. After various experiments to determine the best technic, it was found that the roentgen technic was better; there were no subsequent irregularities of pigmentation in the skin treated; it was quicker; the larger areas of skin could be treated; the areas treated through a filter of 1 mm aluminum responded quicker and better than areas treated without filters or with thick filters. The eruption disappeared; there had been occasional relapses of the erythematous dermatoses which always yielded to roentgen treatment.

THE CAUSE OF CONSTITUTIONAL SYMPTOMS FOLLOWING DEEP ROENTGENOTHERAPY

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and

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AN interesting discussion has arisen within recent years among roentgenologists respecting the cause of certain symptoms following deep roentgenotherapy. Are these symptoms due to acidosis resulting from the specific action of the *x*-rays or to the inhalation of noxious gases produced by the high tension currents and inhaled by the patient, or are they due to some other cause?

To find if possible an answer to this question was the purpose of the studies upon which this paper is based. The observations were made in the laboratories of the Battle Creek Sanitarium. The authors are indebted to Dr. James T. Case, Chief of the Roentgen Department, for valuable suggestions concerning the experimental work on acidosis and for roentgenologic material.

FROM THE VIEWPOINT OF THE ROENTGENOLOGIST

By Dr. Jones

The constitutional symptoms following or accompanying the deep application of roentgen rays, which form the subject of the present paper, consist principally in a feeling of nausea. A detailed description of these symptoms does not enter into the scope of this paper; nor indeed is it necessary to dwell upon them at length, as every roentgenologist is, much to his dismay, acquainted with the unpleasant manifestations from his personal observations in actual practice.

The task of the physician is to alleviate the physical sufferings of mankind, and if this applies with full force to the sufferings that human flesh is heir to in the ordinary course of events, it applies with even greater force to sufferings which, so to speak, are of his own creation—the consequence of the treatment he applies in the form of roentgen rays. Furthermore, it requires neither argument nor discussion to establish the fact that, in order to remedy an evil, the causative factor must be known; otherwise no specific antidote or preventive can be applied. In the absence of any positive knowledge as to the cause of a pathological condition all remedies applied are necessarily empiric and tentative, and we are more or less groping in the dark.

Several authors, including Pfahler and Lange, have discussed the unpleasant symptoms following deep roentgenotherapy, setting forth two main theories to explain their cause and origin. Pfahler takes the stand that nausea results from the gases produced by the high tension current, and that indeed is a very plausible assumption. But if these gases were the actual causative factor, the problem of dealing with the nuisance—for it would amount to nothing but a nuisance in that case—would be delightfully simple. A properly and scientifically arranged ventilation of the room would, to a large extent at least, carry off the obnoxious gases and substitute fresh, wholesome air. But, unfortunately, the theory does not hold good. If it did, how explain the fact that the roentgenologist administering the treatment, the nurses, attendants and

*In the absence of Dr. James T. Case, Major Medical Reserve Corps, now in France.

friends who may be present in the room at the time of treatment, are not similarly affected? It is undoubtedly a fact that they all experience the sensation of the air being impregnated with ozone, but it is equally true that they do not experience that peculiar sensation of nausea that characterizes the complaints of patients upon whom the rays are therapeutically directed.

On the other hand, it must readily be admitted that a patient who experiences physical discomfort in the shape of nausea from whatever cause would receive an additional shock from the presence of obnoxious gases in the air; to that extent the high tension current must be adjudged guilty. Since patients have not, and can not have, any other explanation of their sensation, they would naturally look upon the air they breathe as the source of the trouble. But by logical inference it is clearly not the only, and certainly not the exciting cause of the phenomenon, and we are therefore not justified in stopping our researches and attempts at relief with the problem of improved ventilation. The odor in the room is only an associated cause.

As soon as the attention of roentgenologists was directed to the possibility of the odor being the actual source of the trouble, improved ventilation was resorted to. The effect on the patients, however, was only temporary and to all appearances more psychic than real, especially in the case of patients who had strong convictions that an improvement of the circumambient air would allay their complaints. After a little time, however, when the psychic effect had passed away, they experienced the same manifestations as before.

The theory advanced by Lange is along different lines. Lange attributes these symptoms largely to acidosis, and this theory is likewise plausible. It is fortunate that we have in the Battle Creek Sanitarium the facilities and means at our disposal to put this theory to a scientific test. Accordingly Dr. Paul Roth, of the physiological staff, has given considerable time and study to the problem under discussion, and he has summarized his investigations in the second part of this paper.

FROM THE VIEWPOINT OF THE EXPERIMENTAL PHYSIOLOGIST

By Dr. Roth

Acidosis indicates a failure in the delicate function of a special mechanism by which a proper equilibrium in the acid and base content of the blood is maintained. Variations in the acid-base contents of the blood are allowable only within decidedly small limits, and a step beyond these, particularly in the direction of hypo-alkalinity, is of just as much significance as is a departure from the normal limits of body temperature as indicated by various degrees of fever.

The importance of the use of the clinical thermometer is undisputed and, like the counting of the pulse, is universally resorted to as much because it is easily done as because its value is recognized.

Acidosis is of frequent occurrence and if its detection and the estimation of its intensity were as easily performed as the taking of the temperature or the pulse, the chances are that a clinical search for this departure from the normal would be as often performed. The maintenance of a proper equilibrium in the acid-base content of the blood is done chiefly by the kidneys and by the elimination of CO_2 from the lungs. Until quite recently, a diagnosis of acidosis was usually based upon the interpretation of one or more of such urinary findings as the reaction of ammonia, betaoxybutyric acid, diacetic acid and acetone. Knowing, however, that renal elimination is not always quantitatively proportional to the blood content, it is to be expected that acidosis has been reported at times where it did not actually exist, and that it has not always been recognized where it did occur. Severe grades of acidosis can at times be present without

markedly affecting one or more of the urinary findings above mentioned.

There are now several methods by which acidosis can be accurately and readily determined. Observations upon the blood directly are, or would be expected to be, the most accurate. These methods consist in determining either the hydrogen concentration of the blood as in Marriott's method or the CO_2 combining power of the blood plasma as advocated by Van Slyke. The estimation of CO_2 tension in alveolar air has proven to be most reliable in determining acidosis in any degree of intensity. Space would not allow discussion of the various methods recommended for this purpose. They are based upon the fact that the CO_2 content of the blood as also of the alveolar air is inversely proportioned to the degree of acidosis; the lower the CO_2 tension in alveolar air the more severe is the acidosis. The analysis of the samples of expired air obtained in these various methods is identical, but it is in the manner of collecting these samples that the methods vary.

In our work we have adopted the method I have worked out, which is a modification of both the Haldane and Plesch-Higgins methods. This method commends itself for its simplicity and universal adaptation to all sorts of conditions and for its reliability in obtaining samples for analysis. For a brief description of the method see my paper on the "Estimation of CO_2 Content in Alveolar Air," published in the *Journal of the A.M.A.*, July 31, 1915, LXV, pp. 413–18.

In connection with the work herein reported, great care was taken to secure samples of alveolar air from the patient before and after the roentgen treatment under identical conditions. The patient in all cases was required to sit slightly reclined in a comfortable chair for at least five minutes before the sample was secured. In most cases, the samples were taken in duplicate. It is evident that the results obtained do not indicate the occurrence of acidosis as the result of the roentgen treatment. Even in those cases which showed some degree of acidosis before the treatment, this condition was not increased by the treatment.

Conclusions from Technical Observations

Having satisfied myself that neither ozone-laden air nor acidosis is the real causative factor of the nausea in deep roentgen treatment, I paid special attention to ascertaining whether the roentgen rays produced an effect differing with the part of the human anatomy upon which they were directed. These suspicions were amply confirmed.

In our treatment of deep-seated lesions we were able to give large doses of roentgen rays without arousing any of the unpleasant symptoms until we arrived at the gastric region. It was usually only in that region that the deep application of *x*-rays resulted in nausea and vomiting. In cases such as Hodgkin's disease, where large doses were applied to the axilla, cervical glands and upper mediastinal region, the patients were free from this distressing form of the complaint, but as soon as the lower chest was treated, nausea and sick stomach resulted. This observation was made in a number of patients, and indeed patients realized that it was the treatment over the gastric region that made them sick and would request me not to continue the application there.

I recall a case of splenic leukemia which was given large doses over all the long bones, where the patient experienced no inconvenience whatever. This set in, however, when I proceeded to treat two areas by the crossfire method over the stomach to reach the spleen. The results were quite definite in this case, but no more so than in many others, although special attention was given in this instance to the manifestations for the purposes of the observations I had undertaken.

So much for application of deep rays over the gastric region.

In treating mouth and throat troubles,

I found that patients complained of dry mouth due apparently to an arrest of salivary secretions. One patient with Hodgkin's disease, whose cervical glands had been roentgenized, drank two quarts of water during the night and found it necessary to keep sipping water to keep his mouth and throat moist.

When the region around the salivary glands was treated patients complained of the secretion being changed and of the presence of a brassy taste in the mouth, altering the flavor of food. Thus, one patient who was treated for cancer of the upper maxilla lost all taste for tobacco, while another stated that all food tasted very salty to him after the treatment.

Turning to the treatment of breast cases, I have found that patients complained of loss of appetite. This may have been associated with some vague apprehension of nausea, but there certainly were not the marked symptoms that characterize the treatment over the gastric region.

Considering the fact that in all these observations the technique of the high tension current with its attendant production of ozone was the same, it seems to me perfectly plain that the deep roentgen rays affect different anatomical parts in different ways and accordingly produce different constitutional by-effects.

Thus, in the application of the rays in breast cases I have been led to conclude that it is the irritation of the vagus nerve to which the untoward by-effects should be attributed. A similar observation has been made by Dr. James Ewing, judging by his statement in the *Journal of the American Medical Association* for April 27, 1917, p. 1245, to the effect that "prolonged radiation of the stomach or the vagus nerve is commonly followed by nausea or vomiting," the only difference being that Ewing did not discriminate between the effects of the application of the rays over the stomach on the one hand and over the vagus nerve on the other.

The feeling of dryness in the mouth, excessive thirst, the presence of a brassy taste, the disappearance of the appreciation of taste for otherwise strong substances like tobacco, and the change in the flavor of foods, clearly indicate that the salivary and other glands in the region referred to are strongly affected, causing them to undergo changes of function.

Under these circumstances is it not reasonable to suppose that the gastric glands undergo a similar change from the effects of deep roentgen treatment over the gastric region, resulting in nausea?

From my observations such in all probability is the case, and while a recognition of the facts does not bring us appreciably nearer a solution as to how to obviate the evil, it will at least pave the way to further investigations in a more logical direction than that of gases and acidosis. We have convinced ourselves that the latter are merely contributing factors under adverse circumstances and that even their total elimination would not remedy the evil. It seems natural, therefore, to assume that only improved technique might eventually be able to overcome these undesirable by-effects, and it is to the desirability of such achievement that I wished to call your attention.

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REPORT OF A CASE OF DILATATION OF ESOPHAGUS FROM CARDIOSPASM*

BY ALBERTUS COTTON, A.M., M.D.

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BALTIMORE, MD.

THIS case has been reported in a paper entitled, "A Case of Huge Dilatation of the Esophagus," by Dr. Julius Friedenwald, Dr. A. C. Harrison, and myself which was read by Dr. Friedenwald before the American Gastro-Enterological Society last spring, and will appear in the September number of the *Journal of the Southern Medical Association*.

My report to this Society will be a brief summary of the history of the case with clinical and roentgenological examinations, treatment, and autopsy findings.

History of Case

B. F. C., age 40 years; occupation brakeman; was referred to me by Dr. Z. K. Wiley in December, 1916, for gastro-intestinal roentgenological examination for suspected pyloric stenosis. The very unusual condition shown by *x*-ray examination induced Dr. Wiley to call in consultation Dr. Julius Friedenwald, who assumed supervision of the examination and treatment of the patient.

The essential points in the history of the case are as follows:

Family History.....Negative

Previous History.....Negative

History of present condition—Patient was well until twenty-two years of age. He dates the onset of his trouble from an acute attack of indigestion experienced at this time.

The symptoms complained of were:

(*a*) Eructations and regurgitation of food, both voluntary and involuntary, by mouthful after eating, and continuing from two to ten hours.

(*b*) Nausea often experienced; bad taste frequent.

(*c*) Vomiting when not relieved by regurgitation. No hematemesis.

(*d*) Occasional pain relieved by regurgitation or vomiting.

(*e*) Epigastric fullness and discomfort after eating occurred often.

(*f*) Appetite good and rarely satiated. Patient could eat at one time two-thirds of a loaf of bread, two eggs, two glasses of water and two cups of coffee.

(*g*) Bowels constipated.

(*h*) Headaches.

(*i*) Periods of remission of symptoms of one to two months. For past six months symptoms constant and patient complained of great weakness, with loss in weight of forty pounds.

Physical Examination

(*a*) Pallor and emaciation.

(*b*) Chest.—Lungs normal. Heart displaced downward and to right, with apex beat beneath ensiform cartilage.

(*c*) Abdomen—No palpable tumor, veins enlarged, liver and spleen not enlarged, no tender areas; both external abdominal rings enlarged with small hernias (from strain of vomiting).

(*d*) Urine practically negative.

(*e*) Blood examination: 3,540,000 reds; 7,300 whites; hemoglobin 65%; Wassermann negative. Examination of contents of esophagus after Ewald test-breakfast, 530 c.c. obtained; white, total acidity 25, absence HCl with mucus and lactic acid; microscopically, starch granules—yeast cells—and Opper-Boas bacilli; twelve hours retention of 650 c.c. obtained during life.

Roentgen Examination

Both roentgenoscope and plates were used in the roentgen examination. Most

*Read at the Eighteenth Annual Meeting of the American Roentgen Ray Society, New York, Sept., 1917.

FIG. 1. RESIDUE IN DILATED ESOPHAGUS.
Note small residue in stomach which is situated in left iliac fossa.

of the work was done with plates, twenty of which were taken. The roentgenoscope served to confirm the findings of the plates.

A large barium shadow, conical, but shaped below at base of cone like a reversed stomach, was shown above the diaphragm. After repeated attempts, a plate was obtained showing thin stream of barium extending from large mass above diaphragm to smaller residue in left iliac region. Similar small residues were shown in left iliac region on two other plates, and a shot attached to silk string and swallowed, was shown in same location forty-eight hours after being swallowed. Very marked 12, some 24, and slight 48-hour retention of barium mass above diaphragm was shown by plates.

The roentgenological diagnosis was dilatation of esophagus; partial obstruction at cardia, stomach ptotic in left iliac region. Possible causes of esophageal dilatation considered at the time were: congenital diverticulum; ulcer of cardia with stricture; carcinoma (malignant degeneration of old ulcer of cardia); cardiospasm.

On account of the shape of the barium mass above the diaphragm (reversed stomach), the diagnosis of diaphragmatic hernia of stomach was considered, but quickly dismissed after obtaining evidence of stomach in left iliac region. Attempts were made to treat obstruction at cardia. First, by passage of Einhorn duodenal tube, which failed to pass cardia. Second, by introducing silk thread to be used as a guide for passage of olive bougies. The string reached stomach but failed to pass through pylorus, due to pylorospasm, and this method of treatment was abandoned.

On December 15th a gastrotomy was done by Dr. A. C. Harrison for the purpose of dilating cardia from below. The cardia and upper abdomen were examined for evidence of tumor mass or callous ulcer with negative result. On opening stomach the previously swallowed silk string was found, by means of which graduated bougies up to the largest size were easily passed through cardia from below.

On account of the ease with which the

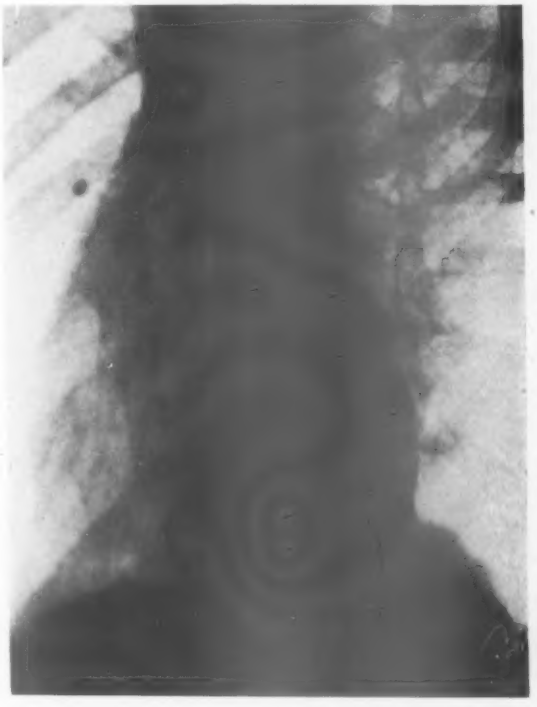

FIG. 2. A LATERAL OBLIQUE VIEW OF THE CHEST.
The barium is shown in the dilated esophagus.

FIG. 3. AN ANTEROPOSTERIOR VIEW OF THE LOWER CHEST AND UPPER ABDOMEN.

This shows the twenty-four-hour residue in the dilated esophageal sac.

FIG. 4. SMALL FORTY-EIGHT-HOUR RESIDUE IN THE ESOPHAGEAL SAC.

Note shot which had been swallowed forty-eight hours previously, in the stomach in the left iliac fossa.

cardia was dilated and the danger of infection from doing gastrostomy at this time, the opening in the stomach was closed.

The patient could swallow and was free from vomiting for a few days, after which he was unable to retain any food and his condition became worse. On December 23rd a gastrostomy was done under local anesthesia. He was fed through the gastrostomy opening but continued to grow weaker, and died on December 25th.

AUTOPSY FINDINGS

Chest:—Left thorax normal. Behind right lung lay the greatly dilated esophagus. It was fusiform in shape, its small end extending to the cricoid cartilage in neck. The sac when removed was found to hold 1,750 c.c. of water. The stomach was normal in size (750 c.c. capacity); position to left with some ptosis. Examination of the dilated esophageal sac and its relation to the cardia showed that the obstruction to the passage of barium mass through

FIG. 5. RESIDUE IN THE DILATED ESOPHAGUS WITH THIN STREAM OF BISMUTH EXTENDING TO THE RESIDUE IN THE STOMACH IN THE LEFT ILIAC FOSSA.

Small diaphragm used inadvertently in this plate.

cardia was mechanical and due to a trap valve at cardiac opening of the stomach caused by the weight of contents at bottom of sac.

The conclusion reached after studying data obtained from clinical and roentgenological examination, exploratory, operative, and autopsy findings, was that this was a case of cardiospasm originally, followed by dilatation of the esophagus.

PRESENT CONDITION OF A CASE OF CONGENITAL DISLOCATION OF THE HIP, REDUCED BY DR. LORENZ IN 1902 *

BY FRANCES C. TURLEY, M.D.

LOS ANGELES, CAL.

FIRST a brief general statement of some facts gleaned from an interesting paper by Dr. P. Le Damany:[1] Hip luxations are thirteen times more frequent than harelip and ten times more frequent than clubfoot, occur about five times in woman to once in man, with greater frequency in the white race than in the oriental or negro, with less frequency in cities than in the country. Congenital hip luxations are unknown in animals. The cause in man is the extreme flexion of an elongated femur within an ovoid uterus. The hyperflexed femur becomes a lever of the first class, the anterior superior iliac spine is the fulcrum; the pressure of the uterine wall upon the flexed fetal knee, the power; and the fixed head in the cotyloid cavity, the weight. The femoral head is thus lifted from the cotyloid cavity, resulting in a leveling of the acetabulum and a torsion of the femoral neck at the superior diaphyseal line. Luxation occurring at birth is by extension.

The case in point, together with five others, was operated upon in the fall of 1902 in the amphitheater of the University of Southern California Medical School, located at Los Angeles.

Dr. C. G. Toland, now a member of our office staff, was present at the operation. He also made the recent physical examination upon which this report is based.

The clinical diagnosis of congenital dislocation of the right hip was confirmed by a roentgen examination made by Dr. Albert Soiland of Los Angeles.

The child was nearly six years of age. The usual bloodless method was employed and the first cast applied.

Dr. P. C. H. Pahl carried out the regulation after treatment, as advised by Dr. Lorenz in these cases, the entire course requiring one year.

FIG. 1. ROENTGENOGRAM SHOWING CONDITION OF HIP DISLOCATION WHEN OBSERVED BY DR. SOILAND.

The child attended kindergarten during the cast period; she entered public school at the age of nine and graduated from High School at the age of eighteen. During this period she ran and played as other children. She climbed trees, rode horseback, and swam. She entered a Training School for Nurses in October, 1916, and is able to perform the regular duties of a nurse in training.

Examination at the present time, August 22, 1917:

[1] LE DAMANY, P., *Amer. Jour. Orthop. Surg.*, Apr. 1914, vol. xi, No. 4.

* Read before the Eighteenth Annual Meeting of the American Roentgen Ray Society, New York, Sept. 20, 1917.

Family History—no sisters, two brothers, and father living and well. Mother living, aged 53 years, has high blood pressure and has had slight paralytic symptoms.

Personal History—unimportant.

Physical Examination—Age, 20 years; height, 5 ft. 7 in.; weight, 170 lbs.; general appearance, robust; walks without a limp. The right gluteal region is flatter and the right thigh and leg lesser in circumference than the left. The spine is straight. There is no perceptible pelvic tilt; there is but a slight difference in length of the lower limbs, flexion, extension, adduction and abduction are not limited.

FIG. 2. ROENTGENOGRAM SHOWING PRESENT CONDITION.

Roentgen Examination—the development of the right femur below the neck is the same as the left. The head of the right femur is deformed, being somewhat mushroomed, and there is a slight coxa vara.

This is the only one of the six cases operated upon known to have a perfect functional result.

Dr. Ridlon,[2] in twenty-nine hips reduced by Dr. Lorenz, and subsequently examined by him, found a perfect functional result in only one-tenth of the cases. Possibly this is due to the after treatment carried out without his personal supervision, for he reports a general good functional result in about 50 per cent. of his operations performed on all cases, at home. American operators claim from 50 to 90 per cent. of good functional results.

From the above we may conclude that congenital dislocation of the hip is a not uncommon occurrence, that the bloodless operation of Lorenz is well worth trying and that the roentgenological field of investigation is large.

[2] RIDLON, J. The Ultimate Results of the Replacement of Congenitally Dislocated Hips. *Jour. A. M. A.*, April 16 and 23, 1904, pp. 1011, 1063.

ROENTGEN EXAMINATION IN PEPTIC ULCER

AT a meeting of the Medical Society of the State of New York, held at Utica from April 24 to 26, 1917, Dr. L. G. Cole stated, according to a report in the *Medical Record* for July 28, 1917, he had long felt that the ascending portion of the duodenum had characteristics altogether of stomach and not of duodenum. Osler's observations corroborated this. He therefore referred to peptic ulcers as being prepyloric or postpyloric, the latter being beyond the sphincter. Morphologically the disease was surrounded by an area of induration and might go down to the muscular coat or farther. That region of the stomach was rendered less pliable as a result, and cicatricial contractions or adhesions might be associated with it. He believed that a small early ulcer could be diagnosed as accurately by serial roentgenology as a fracture of the long bones could be discovered by a single roentgenogram. He showed slides showing the deformity of the cap of the duodenum, cicatricial contraction, burrowing ulcer, and small healed ulcer.

THE AMERICAN JOURNAL OF ROENTGENOLOGY

PUBLISHED BY PAUL B. HOEBER, NEW YORK CITY

Issued Monthly. Subscription, $5.00 per year. Advertising rates submitted on application. Editorial office, 124 Manchester St., Battle Creek, Mich. Office of publication, 67-69 East 59th Street, New York

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"INSTRUCTIVE MISTAKES"

Under this title, the *British Journal of Surgery* conducts a department for case notes which appears to us helpful and instructive. Rare and interesting cases are always of profit, and should be published more frequently than is the case at present.

The particular instance reported in the October, 1917, issue of the journal mentioned is extremely interesting from the *x*-ray point of view. The patient, a shipwright, age 29, reported sick, complaining of pain in the left gluteal region. After twelve days' treatment he returned to full duty. Later, at several intervals, he was returned to the hospital for varying periods of treatment. Finally his case was submitted to the *x*-rays for study, on the strength of which he was reported to have a fracture of the ilium. On the receipt of this report and a history of an alleged previous fall, his case was taken up legally and application made for compensation. Some questions arising, the Admiralty referred him for exhaustive investigation.

X-ray examination revealed that the line of fissure seen in the ilium was not a fracture, but an abnormally large canal for a nutrient artery. There was no evidence of sacro-iliac disease. There was lateral curvature of the lumbar vertebræ to the right, but no evidence of caries of the spine, though there were slight signs of osteo-arthritis of the vertebræ in that region. Clinically, this curvature was detected, and it was noted that there was also marked rigidity of the lumbar spine. The further past history was elicited that at the age of ten years he had an attack of typhoid fever, and this was followed by "trouble in his back," and subsequently by the formation of an abscess, which was opened; the scar of this can still be seen. The case was, therefore, probably one of post-typhoid "rigid-spine" and his pain was due to a sciatica in combination with the lumbar curvature and rigidity.

The interest raised by this case caused the author to examine others. In two or three cases the markings were as noticeable as in the original case.

The most common marking is that of a V-shaped appearance, situated on the body of the ilium close to the sacro-iliac synchondrosis, and this is practically the only one that is apparent in the ilia *x*-rayed in the living subject. The V-shaped mark repre-

sents the canals for the nutrient arteries and their veins. The more central of the arms of the V is found to belong to the canal which gives ingress on the anterior or internal surface of the ilium to the nutrient artery derived from the iliolumbar artery, while the outer arm of the V represents that leading from the foramen on the posterior or external surface of the ilium which is supplied by the nutrient branch of the inferior gluteal artery. At the apex of the V these two separate arteries anastomose, and from that common point send off small branches to nourish the surrounding bone. This common point is situated in the thickest part of the ilium, just above the acetabulum, and above the sciatic notch, and it is reasonable to suppose that this is the true primary center of the ossification of the ilium. The point of junction is practically constant.

On the other hand, the position and number of the foramina for the entrance of the nutrient arteries show a wide diversity. On the internal surface of the ilium, the commonest situation for the foramen appears to be at the lower part of the internal iliac fossa, close to the auricular portion of the ilium which articulates with the sacrum. This foramen is the only one of any size in about 50 per cent. of the cases, but it may be double or multiple, in which case the canals may be too small to be demonstrated by the *x*-rays or by the passing of a bristle. Another position in which an additional or alternative foramen is found is just below the iliopectineal line, above the upper border of the great sacrosciatic notch. This also invariably leads to the common point of anastomosis.

This article is of exceeding interest in demonstrating that it is possible to mistake an unusually large nutrient artery in the ilium for a fracture of that bone; further, it brings out the fact that the nutrient arteries of the ilium, whatever their point of entry, invariably converge to a common meeting-point, which may be considered the true primary center of ossification of that bone. J.T.C.

Roentgen Ray Technicians, "Manipulators"

The United States Army is in need of several hundred roentgen ray technicians. The editors recognize that this term is a misnomer and prefer the term "manipulator" which is employed by the French to designate the lay assistants to roentgenologists. The Surgeon General's Office has already started a class for roentgen ray manipulators and some of them are on their way to France.

A much larger number will be trained in this work as soon as arrangements can be made for enlarging the present school or establishing other schools elsewhere. These "manipulators" not only receive very useful training but in the routine discharge of their duties they come in contact with more varied phases of war work than falls to the lot of the average employee of the army medical service.

The training consists of instruction in the physics and mechanics of roentgen ray apparatus, the care of roentgen ray machines and apparatus, various photographic dark room work and instruction in tube manipulation for routine roentgenographic work.

The editor is authorized to request the readers of this journal to send to the Surgeon General's Office, *X*-Ray Division, Washington, D. C., the names of young men they can recommend for this service.

It will be necessary for all of these men to enlist if they have not already enlisted. There are doubtless already in the enlisted service many young men who would be suitable for this work.

Young men of draft age who are not likely to be called up for immediate service will still be permitted to enlist if they will secure from their local draft board a certification that their number or classification is not liable to early call. The Surgeon General's Office, if addressed as above specified, will be glad to answer any queries regarding this type of medical help.

J. T. C.

TRANSLATIONS & ABSTRACTS

HESS, JULIUS H. The Diagnosis of the Age of the Fetus by the Use of Roentgenograms, *Am. Jour. Dis. of Children*, Vol. 14, No. 6, December, 1917, page 397.

This is an extremely interesting and instructive article which evidently represents a great deal of work. It is often of considerable practical importance to determine the age of the fetus. On the age of the fetus and on its development are based the chief factors that are to be considered before giving prognosis as to the possibility of saving the life of the prematurely born infant. The method of treatment, and especially that of feeding, depends primarily on the age of such infant. In medicolegal cases the question of the age of the fetus may occasionally be of paramount importance, and when only portions of the fetus are available for examination, the roentgenographic method offers the best means for arriving at a diagnosis of the age of such fetus.

Fig. 1 represents a diagram which it would be well to enlarge and place upon the walls of every *x*-ray diagnostic laboratory. This diagram is reproduced herewith. A valuable amount of data has been incorporated in this single plate.

This study is based upon the investigation of fifty-five normal cases which have been determined from the history of menstruation and pregnancy and from other measurements. A number of valuable tables accompany the article. These have been condensed as follows:

TIME OF APPEARANCE OF CENTERS OF OSSIFICATION

Head

Mandible	7th week
Occipital bone (squamous portion)	8th "
(lateral and basilar p.)	9th–10th "
Superior maxilla	8th "
Temporal bone (petrous, mastoid and zygoma)	9th "
Sphenoid (inner lamella of pterygoid process)	9th "
(great wings)	10th "
(lesser wings)	13th "
(anterior body)	13th–14th "
Nasal bone	10th "
Frontal bone	9th–10th "
Bony labyrinth	17th–20th "
Milk teeth (rudiments)	17th–28th "
Hyoid bone (greater cornua)	29th–32d "

Shoulder Girdle

Clavicle (diaphysis)	7th week
Scapula	8th–9th "

Upper Extremity

Humerus (diaphysis)	8th week
Radius (diaphysis)	8th "
Ulna (diaphysis)	8th "
Phalanges, terminal	9th "
basal 2d and 3d	9th "
basal 4th and 1st	10th "
basal 5th	11th–12th "
middle 3d, 4th, 2d	12th "
middle 5th	13th–16th "
Metacarpals, 2d and 3d	9th "
4th, 5th, 1st	10th–12th "

Vertebræ

Arches, all cervical and upper 1st and 2d dorsal	9th week
all dorsal and 1st or 2d lumbar	10th "
lower lumbar	11th "
upper sacral	12th "
4th sacral	19th–25th "
Bodies from 2d dorsal to last lumbar	10th "
from lower cervical to upper sacral	11th "
from upper cervical to lower sacral	12th "
5th sacral	13th–28th "
1st coccygeal	37th–40th "
structural arrangement	13th–16th "
odontoid process of axis	17th–20th "
Costal processes, 6th and 7th cervical	21st–33d "
5th cervical	33d–36th "
4th, 3d, 2d cervical	37th–40th "
Transverse processes, cervical and dorsal	21st–24th "
lumbar	25th–28th "

Ribs and Sternum

Ribs, 5th, 6th, 7th	8th–9th week
2d, 3d, 4th, 8th, 9th, 10th, 11th	9th "
1st	10th "
12th (very irregular)	10th "

Sternum

Sternum	21st–24th week

Pelvic Girdle

Ilium	9th week
Ischium (descending ramus)	16th–17th "
Os pubis (horizontal ramus)	21st–28th "

Lower Extremity

Femur (diaphysis)	8th–9th week
(distal diaphysis)	35th–40th "
Tibia (diaphysis)	8th–9th "
(proximal epiphysis)	40th "
Fibula	9th "
Os calcis	21st–29th "
Astragalus	24th–32d "
Cuboid	40th "
Metatarsal, 2d and 3d	9th "
4th, 5th, and 1st	10th–12th "
Phalanges, terminal 1st	9th "
terminal 2d, 3d, 4th	10th–12th "
terminal 5th	13th–14th "
nasal 1st, 2d, 3d, 4th, 5th	13th–14th "
middle 2d	20th–25th "
middle 3d	21st–26th "
middle 4th	29th–32d "
middle 5th	33d–36th "

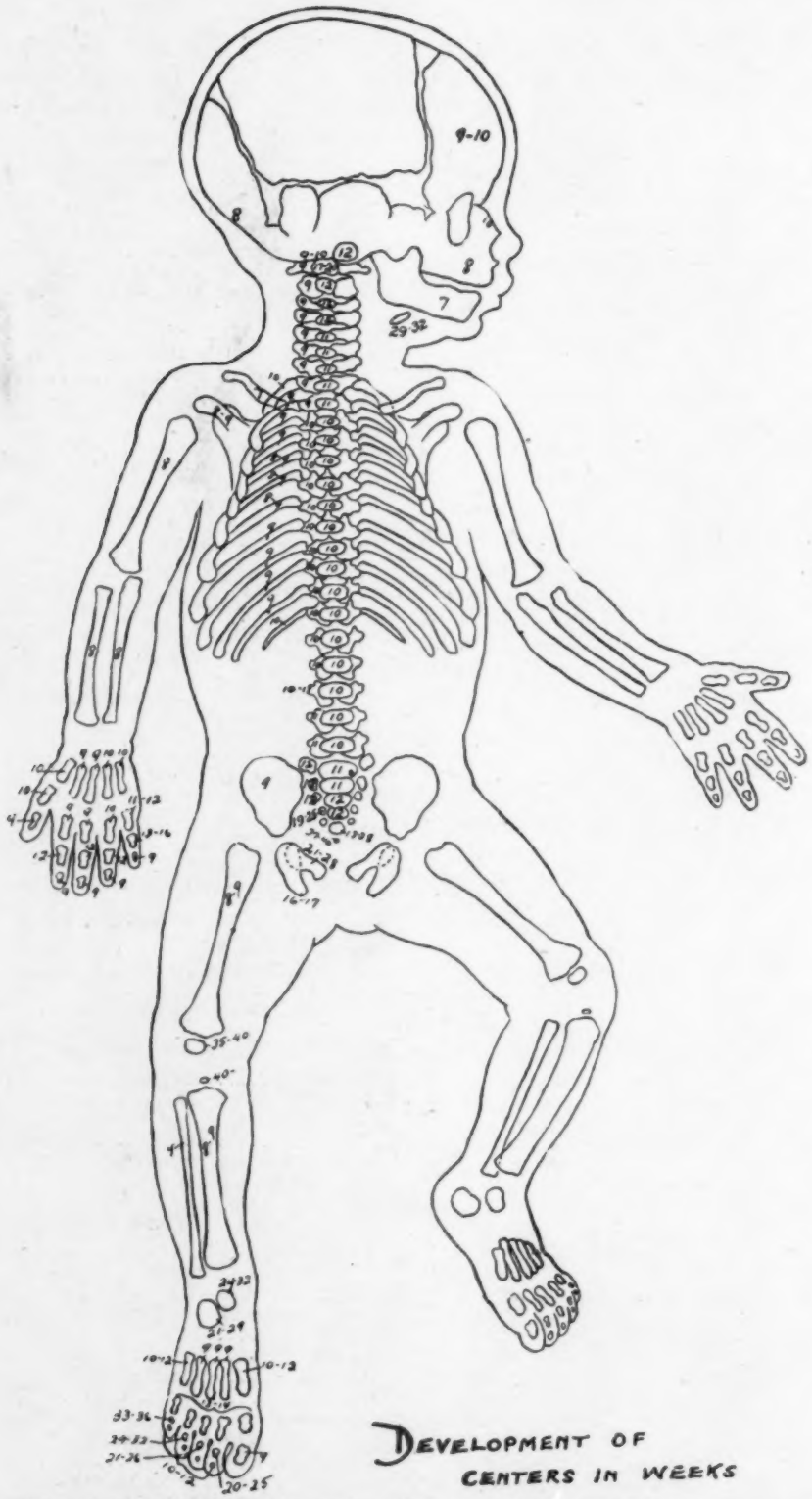

Fig. 1.—Diagram showing osseous development of infant at full term, and development of ossification centers in weeks. Centers shown which are frequently absent at birth: (1) head of tibia; (2) coccyx. Centers omitted in outline: (1) sternum; (2) hyoid.

There are, as might be expected, some variations in the normal process of ossification, and it is also influenced by pathologic conditions of the mother and of the fetus (for example, syphilis, rickets, osteogenesis imperfecta, etc.). In general, these pathologic processes may well be diagnosed in the roentgenograms so that an error may easily be prevented. In some portions of the skeleton the ossification is less regular than in others, and as a general rule the more caudad the portions of the skeleton are, the more they are subject to variations in the process of ossification; and the centers which develop at a later period of fetal life are also more variable. Thus, there are considerable variations in the time of appearance of centers of ossification in the sacral vertebræ. The foot, as a general rule, is unreliable as an indicator of the age of the fetus. The ossification of the sternum is also irregular in the time of appearance, size and arrangements of the centers of ossification.

The author refers to the several roentgenographic studies of the fetus by Alexander, Bade, Hasselwander and Lambertz. Reference is also made to the classical work of Mall.

The estimation of the age of the fetus can be made with greater accuracy in the first half because many more new centers appear during the first months, also because the appearance of the new centers is more constant. The peculiar advantage of the roentgen method for determining the age of the fetus lies in the fact that many centers of ossification are the factors taken into consideration for arriving at definite conclusions. In studying the roentgenograms, the author recommends the use of a reading glass about four inches in diameter.

FUNK, ELMER H. Osteitis Deformans, *Medical Clinics of North America*, Vol. 1, No. 2, September, 1917, p. 451.

The author states that since the first case described by Sir James Paget in 1876, there have been reported up to June 1, 1917, only 232 authentic cases of osteitis deformans. Only three cases of this disease were recognized in thirty-eight thousand admissions to the new Jefferson Hospital in a period of seven years. Hurwitz reported only three cases in thirty thousand admissions to the Johns Hopkins Hospital.

The present article deals with an early case which is reported in full with roentgenologic studies by Dr. W. F. Manges. The disease was of particular interest because it was apparently confined to one bone. The author is under the impression that this case of monosteitic involvement together with a case reported by Bowlby and Hurwitz are the only ones on record in which the disease is limited to the femur.

The reviewer feels that it is unfortunate that so many interesting cases of rare pathology go unreported for he has recently been shown two similar cases while visiting various roentgenologists in this country. He would take this opportunity of urging upon our readers that they should submit for publication in this journal reports of interesting cases which occur in their practice. A brief survey of the literature will add much to the interest of each reported case.

BARLING, GILBERT. Peptic Ulcer Opening into the Transverse Colon, *Brit. Jour. of Surg.*, Vol. 5, No. 18, October, 1917, p. 343.

This case is reported on account of its rarity and because the symptoms were more or less obscure until the roentgenographic examination was made. Three years previously, the patient had been operated upon, a gastrojejunostomy being done for duodenal ulcer. A large cicatrized ulcer of the duodenum was found just beyond the pylorus. A no-loop transmesocolic jejunostomy was done, thread being employed for the outer row of sutures.

The patient was well for a year and a half after which he began to suffer a good deal of discomfort after eating, loss of weight, vomiting and diarrhea. At times he was free from these symptoms. Wasting was rather extreme and there was a curious edema about the legs and abdominal wall. At this time roentgenographic examination showed food passing direct from the stomach through the gastrojejunostomy opening without any delay. The course of the meal was then difficult to follow. Part of it appeared to travel downwards on the left side in the line of the descending colon. It was not possible to say whether it was actually in the colon, or whether it was in the dilated small intestine. Another part of the meal travelled to the right, apparently along the line of the transverse colon towards the hepatic flexure, and within ten minutes of eating the cecum was seen to be filled.

The patient finally died without the surgeon having an opportunity to re-operate. At post-mortem, there was found on the mesenteric border of the jejunum immediately opposite the gastrojejunostomy opening an ulcer about five-eighths of an inch in diameter, but not very deep in most of its extent. The ulceration spreading from this had opened into the transverse colon, where there was a communication about half an inch in diameter between the jejunum and the colon. The margins of this opening were perfectly healed and smooth.

CASE, JAMES T. The Value of *X*-ray in Cholelithiasis, *Annals of Surgery*, Vol. LXVI, No. 1, July, 1917, p. 69.

Case refers to the element of doubt which exists in nearly every clinical diagnosis of gallstones unless the gallstones have been shown on the roentgenographic plate. It is a well known fact that many surgeons no longer make a definite diagnosis of gallstones, preferring to state the diagnosis in a somewhat less definite manner such as gallbladder disease or gallbladder infection. The author recognizes that the negative roentgen findings do not for a moment negative the diagnosis. A number of statistics are cited, both from the author's experience and from the literature, which in his opinion warrant the conclusion that it is definitely possible to show gallstones in approximately 50 per cent. of positive cases, and to show evidence of gallbladder disease in 85 per cent. of positive cases.

O'REILLY, J. J. A. Railway Spine's Little Sister, *Inter. Jour. Surgery*, Vol. 30, No. 11, November, 1917, p. 369.

This article, written by a medical member of the New York bar, is an exceedingly interesting commentary upon the misuse of *x*-ray plates. The article is as follows:

"Traumatic Hystero-Neurasthenia (Neurosis) recently played a successful engagement in the New York Supreme Court (theater). The nominal receipts to the pitiable lady who enacted the title rôle and spoke her lines from a cot carried into Court was $25,000, but an unsympathetic Appellate Court reduced the actual receipts to $10,000. Quite enough, say you? More than enough, say I, in the light of the physical and medical facts in the case, which were evidently not appreciated by the defendant's doctors or attorneys, since no medical evidence was introduced by them to inform the jury that the allegations were utterly at variance with facts of physical and medical science which are so patent as to be almost axiomatic.

"A young woman, age 19, claimed to have fallen into a hole 5 ft. deep and to have landed on both feet and in such a position that her knees were driven up against her stomach. The immediate effect of this force was alleged to have caused some inconsequential cuts, bruises and a sprain, and to have so disarranged her abdominal organs that the stomach was displaced four inches downward and the transverse colon bent into a V shape with the point of the V in the true pelvis (a downward displacement of six inches or more); that the left kidney was displaced downward (distance not stated); that the womb was retroflexed and displaced downward, but what degree of prolapse the testimony did not show; and that the left ovary was displaced downward and backward behind the uterus.

"The hole was near a railroad track, and prior to the accident the woman saw a train several blocks away and, while in the hole, was conscious of this as a recollection. She decided to remain there until the train passed, after which she raised herself by her hands and emerged from the hole, walked several hundred feet, took a train for a distance of several miles to a terminal and reported the accident. She then descended a high stairway to the street and ascended a high stairway to the other side, took an elevated train to a station near her home, got off and had some conversation, reboarded the train and left it at her home station, walked several blocks to her home and went to bed. Next day she walked to the scene of the accident (about five blocks), returned home, went to bed, and when a doctor reached her at four o'clock the next day, 45 hours after the accident, he found her 'nervous and trembling,' and in what he called 'profound shock.' He treated her local injuries and did not know at that time that she had this visceroptosis, but discovered it three weeks later, after three weeks she returned to business and four months later took to her bed and remained there until her dramatic entry into court and thereafter until the following May, nearly fifteen months, during which time she was on a

liquid diet and became steadily emaciated, had constant abdominal pain with acute paroxysmal exacerbations, during which, while constantly losing strength, she was able to pull her 220 pound doctor off his chair, although she was unable to bear the delicate and erudite touch of that doctor's examining hand on the abdomen.

"After the verdict was secured she began to improve so that a few days before her majority, seven months later, she was able to rise from her bed and five months after she ceased to be bed-ridden she presented the appearance of the average healthy girl. She moved at ordinary strolling speed and sat naturally in a chair, crossing her legs, and when changing her position raised her hips from the chair perhaps three inches, sat down with a 'jolt' and recrossed her legs, occasionally bending forward and clasping her knees and generally assuming natural and unstrained positions. For a few moments, while describing the period of taking to bed, she twitched the corners of her mouth from side to side (choreiformly), perhaps five times, but during the time preceding and succeeding this, covering several hours, she did not exhibit this motion.

"The only treatment which this girl received during the nineteen months following her accident was hypodermic injections of morphin twice (and sometimes thrice) a day for most of the days in that period, with occasional use of other sedatives to take the place of the morphin, and toward the end of the bed-ridden stage a surgical corset—and 'she was never constipated in her life.'

"Some *x*-rays were taken of this woman's abdomen, and the visceroptosis referred to was alleged to have been found, but the possibly favorable physical conditions under which that was taken, i. e., holding the breath, full stomach, unevacuated bowels, etc., do not appear.

"A 'nerve-specialist' saw this case, and with the keenness of Sherlock Holmes discovered that this visceroptosis was leading a double life, and in the higher walks of 'Kultured' medicine was a 'Traumatic Neurosis, Hystero-Neurasthenia.'

"Curtain.

"Intermezzo. Business of transferring the case from a lower to a higher court with jurisdiction over larger claims for damages.

"Act II, the Court: Victim on a cot, testifying, medical experts and radiographists in the wings; some characters are missing but the play must go on without them. There is no one to show the jury that the stomach, transverse colon and kidney are anchored in their normal positions by ligaments of white fibrous tissue, which are so delicate that coarse print may be read through them; that a four-inch or six-inch sudden stretch means rupture of some fibers, and, at least, capillary hemorrhage, and that this means foreign matter, free blood, in the folds or upon the surface of the peritoneum and a peritonitis; that the drag of those dropped organs on the remains of their ligaments would mean pain so excruciating that the most stoical would lie in that home and shriek for help instead of clambering out after 'chinning' a car rail at the edge of the hole; that during the trip to and from the railroad terminal she would have been a public spectacle of agony, if not an unconscious passenger in an ambulance; that once in bed she would stay there and not 'view' the scene of the accident the next day; that once down those organs would stay down unless a major operation restored or an abdominal supporter sustained them; that she would not go down into a subway and climb stairs from the subway twice a day on her way to business for four months, and that the very least of her troubles would be constipation and auto-intoxication, even with a liquid diet of cereals. There was no one to explain to the jury that the violence to that kidney would probably strip its capsule, with the attendant pressure symptoms without, and congestive and hemorrhagic conditions within. There was no one to say what the sensitive diaphragm would be expected to do when this pull of the ligaments attached to it sought to drag it, too, downward toward the pelvis, or why that diaphragm did not seek to protect itself from the tug, tug, tug, of these loose organs during her peregrinations and register its protest by a distressing and continuous hiccough. There was no one to ask why this pain should be so agonizing that, emaciated as she was, she possessed the strength to move her ponderous physician from his chair, or why a sensitive abdomen, which could not bear the pressure of her physician's examining hand, could withstand the force of rigid rectimuscles, reinforced by the back, flank and thigh muscles as a brace, so that the pull of her arms might be effective in moving her doctor to his feet, if not to tears. There was no one to show the malign influence of suggestion upon

the mind of this pleader for a portion of another's wealth; there was no one to show that even a V-shaped transverse colon, while anomalous, may be normal for the one who possesses it, or that its displacement may be the result of consistently continuous pressure of distended intestinal organs in the anemic and constipated girl, during her pubescent and adolescent years. There was no one to show that if she fell as she said, in the position she described, and with a force sufficient to displace those organs in the degree alleged, she could not possibly have retained the contents of her rectum, since two things cannot occupy the same place at the same time, and her clothing would be soiled not only by the dirt among which she fell but by the fecal matter within her rectum, since the force was exerted clear down into the true pelvis.

"There will be no return engagement as the incident is closed and the judgment recorded. A revival of such a situation should be impossible in the work of the readers of this column when 'Railway Spine' forms part of the issues of the case."

The moral of this is that in some way, the medical profession must educate its own members and the bench and bar, so that the rule of evidence which will only admit a photograph for "so much as it is worth" as a "representation" or circumstance from which an inference may be drawn, looking to the identity of something, should apply an even stricter rule to the *x*-ray plate and skiagraph, since, in order to make any inference whatever from it, the untrained mind of a juryman must speculate upon the known tissues and contour with which he is familiar, and his judgment is the result of an inference based upon a speculative conclusion which is itself based upon an inferential circumstance, and this is stretching evidence of an expert character much farther than the law intends or human society should tolerate.

ROGERS, MARK H., AND FOLEY, THOMAS M. An Analysis of 75 Cases of Tuberculosis of the Spine in the Adult. (*Am. Jour. Orth. Surg.*, March, 1917, XV, 208.)

Tuberculosis of the spine in adults is more common than has been supposed, and differs materially from the disease in childhood. The diagnosis in adults is difficult and in this series an average of two years and two months elapsed before an accurate diagnosis was made. The first evidence of the disease in six cases was paraplegia, in five cases abscess. Previous diagnoses had been back-strain, lumbago, sciatica. Four cases had been considered gastro-intestinal, one had been operated upon for gallstones, one for appendicitis, one for perinephritic abscess, and one had had a nephropexy. Paraplegia was most common in the dorsal group, and abscess in the lumbar group. *X*-ray findings of the dorsal group in cases with no clinical evidence often show circumscribed abscess formation which does not spread. Most cases can be demonstrated roentgenologically to have some evidence of abscess. The kyphos is seldom large and produces but slight deformity. End-result was determined in 20 of these cases and showed 75% of good results. The principle of treatment is the same as with children,—rest in recumbency during the acute stage, fixation and protection for the duration of the disease. Bone grafting is advised in the dorsal region for the greater fixation and shortening of the time of treatment. It is especially adaptable for adults.

HETZEL, W. B. Isolated Disease of the Scaphoid Bone of the Foot (Köhler's Disease.) (*Am. Jour. Orth. Surg.*, March, 1917, XV, 214.)

General discussion and report of one case. Roentgen ray showed scaphoid smaller than normal, irregular in outline, no distinction between cortex and spongy portion, and much increased in density. Foot was immobilized in plaster of Paris. After three months the scaphoid had increased in size and decreased in density toward normal. According to Köhler the scaphoid shows changes in four ways: 1. One-half to one-quarter smaller than normal. 2. Form entirely irregular. 3. Architecture impossible to recognize, cortex and spongy portion running together. 4. Density increased two- to four-fold. This disease is a clinical entity, probably inflammatory, of an osteochondritic nature with typical radiographic picture and of good prognosis.

PERCY, JAMES F. The End-Result of the Treatment of Inoperable Uterine Carcinoma by Heat. (*Med. Rec.*, June 16, 1917, p. 1063.)

In his paper on the above subject, read before the Annual Meeting of the American Medi-

cal Association, Percy claimed that, although his method of applying low heat to the uterus for inoperable cancer was only palliative, it was well worth while if only for the fact that the patient was relieved of the offensive discharge. In the discussion the consensus of opinion was by no means altogether in favor of the Percy method, and Dr. Bailey, of New York, stated that he had used the method with radium treatment following, but had only the same number of cures as when he had used radium without an abdominal operation. He thought the roentgen ray might be utilized to find out just the line of demarcation where influence of the heat ended.

STEIGER. Arrest of a Malignant Intracranial Tumor by the Roentgen Rays. (*Correspondenzbl. f. Schweizer Aerzte*, March 10, 1917. Ref., *Med. Rec.*, May 26, 1917, p. 904.)

At a session last fall of the Berne Medico-Pharmaceutical Society Steiger presented a woman, aged 31, who had recently successfu ly undergone roentgen treatment for the following condition: Less than five months before she presented right exophthalmos and lockjaw, and the latter symptom greatly interfered with nutrition. The sight of the right eye began to fail, and ptosis and ophthalmoplegia developed. There was a painful swelling above the right zygomatic arch. A roentgenogram showed an enlarged sella and the diagnosis lay between tumor of the hypophysis and sarcoma of the base of the skull—probably the latter.

The tumor was rayed in all directions concentrically. Very hard filtered rays were used. In all there were 12 fields, 3 of which were used in a session of thirty minutes, daily sessions at first, after that somewhat irregularly, 1, 2, or 3 days of intermission. A roentgen dermatitis developed, but in the meantime considerable improvement had taken place. After an unavoidable absence of the patient for a month, radiation was resumed in three fields only. The exophthalmos was completely gone, and the eye was almost normal in all respects save vision, which had not returned. The jaws could be opened voluntarily to the extent of three centimeters without forcing. The patient looked and felt well.

NORDENTOFT, S. Roentgen Treatment of Brain Tumors. (*Ugeskrift for Læger*, May 17, 1917. Ref. *Jour. Am. Med. Assoc.*, July 14, 1917, p. 160.)

Nordentoft has now a record of twelve cases of brain tumors in which roentgen treatment has been applied and he reports complete success in three instances. The improvement was most marked in the better vision. Rapidly developing tumors are more liable to give good results than the more slowly growing. Symptoms from stasis and compression subside as the cause is removed. The loss of hair over the region was not permanent in any instance. The cure has persisted to date, the longest interval being a year and a half. Choked disk retrogressed in some of the cases, in one after it had lasted for three years. He advises a tentative course of treatment as for syphilis before beginning the roentgen treatment, and urges that the latter should always be tried before attempting an operation. Gulstad reports the details of the twelve cases with the findings on which the diagnosis of a brain tumor was based. Two of the twelve patients proved refractory; necropsy in one showed a very old fibrous tumor. In eight the roentgen treatment gave favorable results; in three cases earning capacity was restored. It is emphasized that these experiences seem to prove that the roentgen rays can be applied to the skull without injury to the brain and that the tumors can be modified through the skull wall.

RADIUM TREATMENT IN MANCHESTER (ENGLAND). (*Lancet*, CXCII, April 7, 1917, p. 547.)

The report for 1916 of the Manchester and District Radium Institute, as furnished by Dr. Arthur Burrows, the radiologist of the Institute, contains amongst others, the following particulars:

The year under review saw the completion of the first thousand cases presenting themselves for radium treatment during the two years' existence of the Institute. Included in the report is a list of all the malignant cases except rodent ulcer which were well at the end of 1916. This list states the time during which the patients have remained free from symptoms or signs of disease. No case of carcinoma of the breast was reported as being

apparently well at the end of 1915 and, therefore, in this particular instance, twelve months is the maximum period during which a patient previously suffering from this disease can have been free from symptoms. During the year the Institute has limited itself to the purely clinical side.

A series of cases illustrating interesting points in relationship to radium treatment is given, among which those dealing with carcinoma of the breast and with tumors of the abdominal muscles deserve special mention.

The best results in mammary carcinoma followed the implantation of emanation tubes, as many as twelve having been buried at one time. In tumors firmly fixed to the chest, the results are not so good and implantation may produce an intractable ulcer, unless extreme caution is observed. In such cases mere external application of plates may be preferable to the insertion of tubes. The opportunities for local repair should always be considered. An exaggerated growth of the breast is best removed, and radium applied at the site of removal and along the lymphatic tract. Inoperable or small, scattered glands of the neck, small secondary skin nodules are also usefully treated with radium.

As to tumors of abdominal muscles, the report contains the clinical histories of three cases which are interesting from the point of view of diagnosis and radium treatment. The first case is one of true sarcoma of the left rectus, and the other two are examples of fibrosis of the abdominal muscles and chronic interstitial myositis, respectively. The case of sarcoma yielded very slowly, while the other two cleared up extremely rapidly.

RADIUM TREATMENT IN EDINBURGH (SCOTLAND). (*Lancet*, CXCII, April 7, 1917, p. 546.)

Dr. Dawson Turner, who is in charge of the Radium Department at the Royal Infirmary of Edinburgh, has forwarded a report covering the year 1916 to the *Lancet*, from which the following interesting particulars are abstracted.

Out of a total of 520 patients, 66 were treated with radium, as against 64 in the preceding year. The complaints were distributed as follows: Rodent ulcer 28, malignant disease of the vagina and cervix 7, malignant disease of other parts 18, exophthalmic goitre 7, nevi 4. Sarcoma proved more amenable to radium than carcinoma and sometimes disappeared in a remarkably short time. Rapidity of growth is no contraindication to the use of radium, as rapidly proliferating cells readily yield to it. This leads Dr. Turner to ask the question whether all sarcomas are equally amenable to radium treatment and, if not, what conditions determine the sensitiveness, but he fails to supply the answer.

The difficulty in treating malignant disease of the vagina and cervix with radium lies chiefly in the comparative inaccessibility of these parts, and this difficulty is enhanced in recurrences which are usually located in more inaccessible parts yet. A further difficulty in this respect is that the surviving cancer cells are more refractory to radium than those that were destroyed by the first application. But even so, the intermediate cure always greatly benefits the patient by the removal of pain, cessation of discharges and general gain in health and strength.

The beneficial action of radium on rodent ulcer is generally admitted, and superficial uncomplicated cases invariably do well if the available amount of radium is sufficient. In the cured cases there is scarcely any contraction of the skin, but when situated on mucous membrane, the affection is less amenable, and Dr. Turner prefers to divide the necessary dose into two or three, administered at three or four days' intervals. To prevent recurrences, the deeper parts should receive as adequate treatment as the superficial ones.

Of the seven cases of exophthalmic goitre, one died of hyperthyroidism in less than a month after treatment, while the others were benefited.

The report concludes with the clinical history of ten of the more important cases other than rodent ulcer, in which radium treatment had favorable effects in varying degrees.

CLARK, JOHN G. Results Obtained by the Use of Radium in the Treatment of Cancer of the Uterus. (*Ann. Surg.*, Nov., 1916, Vol. LXIV, p. 602.)

Clark bases his article upon the results obtained by the use of radium in the treatment of cancer at the University of Pennsylvania Hospital at Philadelphia. He first refers to the

limitations of the applicability of the surgical treatment of cancer. Approximately 80 per cent. of the cases of cancer of the uterus received for examination at the University of Pennsylvania Hospital were inoperable, only 20 per cent. of the cases being considered within radical operative limits. This statement was based upon the fact that within the last two years 49 cases of inoperable cancer of the uterus were treated with radium, and during the same period only 12 cases were considered as suitable for radical operation.

The results of the radical operation have proved conclusively that, with very rare exceptions, the hopeless cases are those of the metastatic type. In carcinoma of the fundus the statistics of various surgeons do not differ to any marked degree, because extirpation of the uterus generally suffices to give good results. So long as the growth is confined to the fundus, recurrence does not take place in more than 50 per cent. of cases, provided even simple hysterectomy is performed. We are all fairly well satisfied with the results of operation in cancer of the fundus, whereas no one regards the operative treatment of cancer of the cervix with any great degree of optimism. To attain a higher measure of success, some more efficient means than the scalpel must be employed. This remedy has not as yet been discovered. Notwithstanding the remarkably good results that have followed the use of radium, the author still adheres to the dictum that the uterus and all possible adjacent tissue, if the growth is very limited in its extent, must be extirpated. Beyond this point, however, he has grown quite conservative.

The crux of the situation, therefore, as our experience has taught, is to attempt surgical measures only in the clearly operable cases, leaving the large remainder to secure relief from therapeutic efforts, which give as good or, as we now believe, even far better results from the use of radium.

In the inoperable cases, Clark believes, the Percy cautery holds out a distinct hope; nevertheless, he does not share the great degree of optimism shown by the inventor of this method as regards the cases of widespread extension. His experience at the University of Pennsylvania Hospital convinces him that radium offers the most helpful outlook of any remedy thus far presented in the palliative and occasionally the curative treatment of the borderline and inoperable cases. Of 69 cases reported treated up to September, 1915, the malignancies involving the uterus, vagina and urethra, practically all of these would, according to our past standards, have been classed as inoperable and, therefore, would inevitably have been doomed. Of these 69 cases, 13 died during the first twelve months following treatment. Ten were not traced. Of the remaining 46, two were alive at twenty-two months; three at eighteen months; seven at twelve months; and seventeen at six months.

Radium, as is shown in our series of cases, is by no means a universal panacea for cancer, even when the growth is strictly localized. There is no way of determining which cases will be benefited by its use. There is beyond doubt a certain percentage—how small or how great we cannot tell from our experience—in which cancerous growths are not retarded by radiotherapy; indeed, occasionally it would appear that there is a positive acceleration of growth.

Clark quotes Schauta's experience. In Schauta's first series he used radium in too large amounts and too often, with most disastrous results. One patient died of pyonephrosis; eight patients showed steady loss of weight, with diarrhea, tenesmus, fever, vomiting, headache, and reduction in blood count. The autopsy findings showed severe necrosis and fistulæ with diphtheritic and purulent inflammations of the rectum and bladder, sigmoiditis, and ulcerative processes in the pelvic coils of the ileum. *One striking point, however, noted at the autopsies was that in not a single instance was a trace of local carcinoma found.* In the method of its application, however, the remedy proved far worse than the disease, but this investigator established beyond question that radium emanations were absolutely destructive to cancer cells. The more moderate dosages employed in his later series of cases gave eight apparent cures out of eleven patients treated, and in no instance were fistulæ or necrosis produced, and the weight and general condition of the patient showed marked improvement.

Schauta's later technic is as follows: From 30 to 50 mg of radium, filtered through 1.1 mm of gold, 1 mm of platinum, and 0.75 mm of brass, are applied in from 5 to 8 exposures of 12 hours each, at intervals of from one to sev-

eral days; an interval of rest of three to four weeks is then allowed to elapse, followed by a second but shorter exposure, and in some cases, after another interval of two to three weeks, a third series of applications is employed.

As an evidence of the widespread skepticism concerning these newer remedies, and in spite of this very favorable personal experience, Schauta declares that, although he will use radium in advanced cases, he will still continue to employ Schuchart's radical method of performing vaginal hysterectomy in the clearly operable cases, reserving radium as a post-operative prophylactic agent. It would also appear to be a self-evident fact that the post-operative effects of the Percy method must fall far short of those of the radium cases.

Clark concludes with the following important observations: "Removal of the uterus in cases of cancer of the fundus has yielded such good results that I do not feel we are justified in taking any chances with radium, not even in the borderline cases. *Our attitude toward the cervical and fundal growths is diametrically opposite. In borderline cases of cancer of the cervix we invariably employ radium. In advanced cases of cancer of the fundus we invariably perform a hysterectomy.*"

HOLDING, A. F. AND BROWN, S. The Treatment of Hodgkin's Disease. (*Jour. Am. Med. Assn.*, Mar. 3, 1917, Vol. LXVIII, p. 701.)

In the past three years these authors have had under observation eighteen cases of Hodgkin's disease. The diagnosis in each case was verified by microscopic study. Seven of the patients were males and eleven females. The ages varied from six to fifty-six years.

The following is a summary of the authors' conclusions:

1. Microscopic examination of the tissues in all cases of enlarged nodes, especially in the neck, is to be recommended.

2. Attention should be called to the fact that cases of persistent idiopathic pruritus may be due to Hodgkin's disease.

3. The treatment of Hodgkin's disease is unsatisfactory. No efficient treatment is known. The treatment recommended is that in vogue for malignant tumors and occult infections. The results to be expected are temporary ameliorations.

4. Recoveries are rare. Of the thousands of patients treated there are only two authentic cases in which the patients are reported symptom-free after five years.

5. The roentgen ray and radium are the only new agents found beneficial in this disease, and should be used in treating it, at least after operation.

6. A roentgen examination of the chest is indicated in all cases before an extensive surgical removal is considered. This will save many patients from a needless operation.

EWING, JAMES. Radium Therapy in Cancer. (*Jour. Am. Med. Assoc.*, LXVIII, No. 17, Apr. 28, 1917, p. 1238.)

In a dispassionate article dealing with the present status of radium as a curative agent, Ewing reviews the successes and failures of this therapy and, based upon his observations and experience, ventures upon a prophecy as to the therapeutic employment of radium in the future.

While the chief value of the article lies in its logical inferences and should therefore be followed in its details, an abstract of some of the more important statements may be read with profit and interest. Thus, Ewing is responsible for the statement that the action of radium on cellular tumor tissue is selective and specific in the sense that tumor tissues are from 4 to 7 times as sensitive as most normal tissue. The uncertainty of progress is due to the fact that little is definitely known of the mode of action of radium. That its action is electrical may be conceived, but is not demonstrated. The appearance of the cell cytoplasm suggests hydrolytic cleavage of cell protein, and this seems to excite leucocytic emigration. The growth of capillaries may be explained as a regenerative process, following a loss of tissue equilibrium or it may involve a direct stimulating action of the radium on endothelium and fibroblasts. In any event, the process is very complex, and in many cases there are very strong hints at a restoration of normal resistance of the connective tissue against lawlessly proliferating tumor cells.

Reviewing the practical achievements, Ewing has not found any exaggerated statements of its value in recent accredited medical literature, whilst warnings against the use of radium

regularly come from persons who have had little experience in the use of it. To inform the public that radium has failed in the treatment of cancer is to misstate the facts.

The condition laid down by surgical opinion that radium must be tried out on inoperable cancer has generally been accepted and on the whole is a wise restriction. The effects of radium are confined to a limited territory and have no influence on disseminated tumors. The attempt to control a large territory leads to the use of excessive doses with serious results. The limitations of radium should be recognized, but its failures in this class of cases should not prejudice its claims elsewhere. Only palliative efforts should be attempted, when there is no possibility of reaching all the invading tissues.

Ewing lays down the following indications for the use of radium in inoperable cancer, when considerable quantities of the agent are available in the hands of an experienced operator.

Radium should not be withheld from rapidly growing, deep-seated and bulky tumors, for the cellular structure of many such tumors is just that much susceptible to the action of large amounts of radium at a distance from the skin and over long periods. Radium should be employed in combination with a limited operation in those forms of cancer where operation alone yields particularly unfavorable results, as in cervix of the uterus, prostate, tongue, pharynx, antrum, and in lymphosarcoma. In very advanced cases, only cautious, palliative treatment is allowed. Much of the distrust against radium has arisen from the untoward effect of overtreatment of inoperable cases and not from its proper use in suitable conditions.

The capacity of radium to eradicate cutaneous carcinoma is now a routine experience. In certain derivatives of basal cell carcinoma, as in mixed tumors of the salivary glands, radium has had notable success and should usually be employed in preference to operation. Among the refractory cases are recurrences after operations, carcinoma following lupus, invasion of bones, location near eye or nasal sinuses, in thin skin or bony prominences, and after repeated ineffectual exposures.

Ewing cites a number of authors who have reported highly favorable results in radium treatment of carcinoma of the cervix and body of the uterus, the details and figures of which need not be repeated here. Our present knowledge of the favorable results in cancer of the rectum, mouth and tongue is likewise summarized. The author further calls the attention of radium workers to osteogenic sarcoma, inasmuch as roentgen rays have had a favorable effect upon this distressing form of malignant disease, and surgery has proved extremely unsatisfactory. In mammary carcinoma favorable results have been attained, while in esophageal carcinoma, where the difficulties of application are great, at least palliative results have been reported.

The author demands a closer study into the limitations of radium therapy and a standardization of methods as well as concentration of the work as far as possible in large clinics thoroughly equipped with radium, technicians and trained medical specialists. The mechanical difficulties are still very great, and the various expedients to protect the normal tissues are still far from uniformly effective. Incidentally the author states that he has never observed any initial stimulation of tumor growth either under radium or roentgen treatment.

A serious objection to the use of radium in advanced cases is the failure of long inflamed granulation tissue to heal after the tumor cells have been destroyed. It appears to be necessary to attack the tumor before it has laid down much dense connective tissue, as otherwise the normal reaction by cellular granulation tissue fails to occur while the tumor cells resist the direct effect of the rays. He has also found that the susceptibility of normal tissue to repeated applications of radium seems to increase, while the sensibility of tumor cells seems to diminish after several exposures. Hence the best effects in advanced lesions often follow a single massive dose.

Recurrences after radium treatment have been rather frequent, but it should be recalled that they have been observed with few exceptions in advanced inoperable cases and that there is no means of comparing their frequency with those following operation in less advanced cases. But in view of the many practical limitations to the use of radium, the author considers it unwise to spread among the general public the impression that radium is ready to supplant surgical treatment of operable cancer. On the other hand, these precautions

should not be permitted to stand in the way of the legitimate extension of radium treatment.

As to the probable future of radium therapy in cancer, the author sees no indications that the intravascular injection of radium will have a favorable effect, preliminary reports to the contrary notwithstanding. But he believes that by increasing the quantity, the length of exposure and the distance from the skin many deep and locally extensive tumors may be inhibited or destroyed. He also touches upon the propriety in future treatment of employing radium in operable malignant tumors and seems to be ultimately in favor of it. Starting with demonstrating the capacity of radium to control superficial cutaneous tumors, he would also give it a trial in all accessible and strictly localized carcinomas, but he would select cases in which there was some contraindication to operation. His next step in the argument is that, as a rule, the same conditions that are favorable for operation are also favorable for radium, and inasmuch as radium treatment of the future should be more than a mere palliative, he thinks that certain forms of early and strictly operable cancer may on the whole be more satisfactorily treated with radium than by surgery. However, he does not advocate this "at the present moment," but he believes it to be a consideration that can not be ignored in estimating the value of radium therapy.

STEIGER. Newest Problems of Roentgenological Treatment of Cancer. (*Cor.-Bl. f. schweiz. Aerzte*, Dec. 9, 1916. Ref.: *Med. Rec.*, Jan. 20, 1917, p. 120.)

Steiger has now treated 200 cases of uterine and other genital affections with roentgen rays. In regard to operable cancer he has not yet come to substitute the latter for the knife, but he irradiates all cases after operation. Not to do so would be inexcusable, for while recurrences can not be suppressed altogether by this means, their number can be greatly reduced. In roentgenizing inoperable cases the possibility of cure is always present, although as a rule the disease is only held in check and its distressing symptoms mitigated. An inoperable growth is not necessarily a neglected growth, for it may also mean a cancer of unusual malignancy. If the rays can prevail over such cases, they ought to be efficacious in the technically operable cases, in addition to doing away with operative mortality. But at present the knife achieves a good share of actual cures, when figured on a basis of five years' freedom from relapse. The rays can not as yet make a similar showing. Deep roentgen treatment hardly goes back as far.

The author has thus far treated 26 inoperable cancers of the uterus. In three of these he obtained a clinical cure and in four others a favorable result. Eleven of the women are dead. The entire number of malignant inoperable cases treated were 50, of which 15 have been improved. This includes all localities and all forms of malignancy.

An entirely different series is that of 34 cases of prophylactic roentgenization after operation. Of this number 14 were situated in the uterus. All the patients have been under control. There has been but one recurrence, now under treatment, as are also six others which are still free from symptoms. The other 5 return periodically for inspection and are still sound. The author has roentgenized 17 cases of cancer of the breast after operation. One is dead of cachexia and two have local recurrence; five have disappeared and three are still under treatment.

MERCIER, M. Roentgen Therapy in Muscular Sclerosis Following Contracture. (*Paris Médical*, Dec. 2, 1916; Ref.: *N. Y. Med. Jour.*, Jan. 20, 1917, p. 131.)

Mercier points out that in military practice sclerotic muscular conditions following persistent contracture or myositis have given considerable trouble. Four cases presenting retraction of the biceps, the result of wounds of this muscle or of its tendon by shell fragments, were recently treated by roentgen rays with promising results. None of these patients had been able to extend the forearm more than 90 degrees. Converging rays to the extent of two H units were used upon the muscle tissue of the biceps, first on one side and then on the other. A filter of 1 to 1.5 mm of aluminum was used, and weekly treatments were given. After eight or ten sittings all these patients were able to extend the forearm up to 150 and even 160 degrees—a gain of 60 to 70 degrees.

GOETJES, H. The Etiology of True Loose Knee Joints. (Tenth Anniversary of the Cologne Medical Academy. Ref. *Zentralbl. f. Roentgenstr.*, 1916, Nos. 5 and 6, p. 154.)

If, according to the author, in a loose joint near the insertion of the cross ligaments of the femur and of the tibia, there is a cartilaginous defect from which the loose joint originates, the latter is of traumatic origin and not due to osteochondritis desiccans, even in cases where the anamnesis is traumatically negative. This statement is based on anatomical examinations and roentgen findings which were later confirmed at operation. In three cases out of four he found that there was a tear at the tibial end of the lig. cruc. post., and in the fourth case there was a tear at the femoral end of the same ligament. The tension of the cross ligaments or their fascia does not occur all at once, but runs a course according to prevailing anatomical conditions in such a way that the extreme fibers undergo tension first, followed later by that of the others, as the movement progresses. The most important complicating factor is the motor mechanism, and in the latter it is the inward rotation of the lower leg which is principally responsible for the state of affairs.

GREEN, A. A. RUSSELL. A Record of Sixty-one Cases of Neoplasmata of the Skin Treated by X-rays or Radium. (*Lancet*, CXCII, April 7, 1917, p. 544.)

The results of roentgen and radium treatment in sixty-one cases of malignant neoplasm of the skin, which were admitted to the Birmingham (Eng.) Skin Hospital during the past four years, seem to be capable of division into good, bad and indifferent according to the details furnished by the author. Besides, twenty of these cases failed to reply to a circular note asking for information about their present condition. The treatment seems to have been tentative and adapted to the peculiarities of each case rather than modeled on a fixed principle admitting of comparison, and the condition of the patients is not sufficiently described to admit of any thorough-going conclusions as to the effect of the treatment adopted. However, the author describes his "method of dosage" as follows:

"The radium in use is pure radium bromide, and is certified as such by the Curie Laboratory. It is spread on metal plates in the proportion of 5 mg to each square cm. of surface. The roentgen rays were employed as full or fractional Sabouraud doses, this being the quantity of roentgen rays required to bring about the fall of the hair of the scalp without visible reaction, or permanent injury to the hair follicles, and is a sharply defined dose."

Besides this, the author has found two methods of supplementary treatment useful, consisting in electrolysis and autogenous vaccines. Electrolysis for the small nodules that are sometimes left at the periphery of the scar and which are liable to become centres of subsequent relapse, has proved much more useful to him than the application of carbonic acid snow. In one of his cases, concurrently with the first exhibition of radium, he transfixed the base of the epithelioma with an electric needle in some half dozen places. In cases that have been obstinately septic, he has found autogenous vaccines of great value.

Of all cases that could be traced, sixty-six per cent. were healed and have remained healed for the following periods:

Between 3 and 4 years	7
" 2 " 3 "	4
" 1 " 2 "	9
Under 1 year	4
Relapsed	2

Of those treated by radium 70 per cent. were healed, of roentgen-treated patients 43, and of those who had radium and roentgen treatment 66 per cent. The author admits that the results from so small a number of cases are misleading, but he believes they go to demonstrate the following conclusions:

(1) The administration of radium in less than one hour doses of the strength specified is likely to prove unsatisfactory, although small doses of roentgen rays and radium will sometimes bring about healing.

(2) Radium will heal when roentgen rays have failed.

(3) In most superficial cases screening is not necessary.

(4) Cases that are going to do well will do so within six months, and if they have not done so within that period, a drastic revision of the treatment is imperative.

(5) Electrolysis and autogenous vaccines are useful as supplementary methods of treatment.

(6) Caustics are contraindicated.

THERSTAPPEN. Traumatic Malacia of the Os Naviculare and Os Lunatum. (Tenth Anniversary of the Cologne Medical Academy. Ref. *Zentralbl. f. Roentgenstr.*, 1916, Nos. 5 and 6, p. 156.)

This is a description of two roentgen exposures of traumatic malacia of the os naviculare and of three of the os lunatum. The injuries were caused by overstretching the wrist. The author contradicts Preiser who attributes these changes to tearing of the ligament. He rather holds nutritive disturbances responsible for the cause of the affection. The author also describes the roentgenological and microscopic findings of several artificially produced injuries and circulatory disturbances of the calcaneus of a rabbit.

BELOT, J., AND FRAUDET, H. Localization of Foreign Body in the Eye. (*Jour. Radiol. and Electrol.*, Paris, Vol. II, No. 7, Jan., 1917. Ref. *Jour. Amer. Med. Assoc.*, June 9, 1917, p. 1786.)

Belot and Fraudet emphasize the advantages of rapid roentgenoscopy and of roentgenography in five positions according to a geometric system they have devised and here describe with twenty illustrations and a large plate. With this system they were able to locate minute scraps even of aluminum, stone or glass, which are relatively transparent for the roentgen rays. In one instance Belot thus localized a fragment from a test tube; the particle of glass was 1 mm long by ½ mm wide and thick. They say localization with the stereoscopic technic is possible only when the eye is incapable of any movement. The preliminary roentgenoscopic examination, after the patient has sat for twenty minutes in an absolutely dark room, serves to locate the foreign body in one quarter of the orbit and may locate it with sufficient precision. If not, they proceed to roentgenography. As the eyeball revolves on its transverse or vertical axis, if the foreign body changes its place proportionally to the displacement of the periphery of the eyeball, then the foreign body must be in the eyeball itself or the muscles in contact with it. If the foreign body is in the parts outside the eyeball, its displacement with different movements of the eyeball occurs according to geometric principles. Study of the type of displacement shows at once the muscle involved. In twenty-five cases in which this technic has been applied the foreign body was found exactly at the point in the operative cases. An error of a few millimeters in localization would be negligible elsewhere, but the eye is unable to stand any groping. Even with intermittent screen control, compasses, etc., we have no guarantee of success, but the system here described is incapable of failing, it is asserted, provided the eyeball is movable and vision is not lost in the other eye. All that is required is to outline a curve, drawing the outline on transparent paper placed over the five radiographs in turn. The tracing thus obtained locates the foreign body with precision.

KEELER, J. CLARENCE. Fracture of the Tympanic Plate of the Temporal Bone. (*Laryngoscope*, Vol. XXVII, No. 3, March 1917, p. 192.)

Fractures of the tympanic plate of the temporal bone are so rare that many of the leading textbooks either on surgery or on otology fail to mention the condition. Dr. Keeler recently presented at the Philadelphia Laryngological Society a patient, a girl of 17, who had sustained considerable injuries to her head by being thrown from a motor cycle. The roentgenograms showed the fracture at the symphysis, the broken teeth, a fracture of the left condyle of the mandible and a fracture of the tympanic plate of the temporal bone with upward displacement.

The Introduction of Roentgenograms as Evidence. (Medicolegal Notes, *Med. Rec.*, Feb. 17, 1917.)

In an action for permanent injury caused by being struck by an automobile, roentgenograms of the broken bones of the plaintiff's leg were permitted to be exhibited to the jury, although they were calculated to shock a layman and might create an impression of much graver injury than a surgeon would understand existed from a consideration of them and so result in much increasing the size of the verdict.—Berg vs. Mitchell, 196 Ill. App., 509.

BOOK REVIEWS

LE TRAITEMENT DES PLAIES INFECTEES. (Treatment of Infected Wounds.) By A. Carrel and G. Dehelly. 177 pages, with 78 text illustrations and 4 plates. Paper cover, price 4 francs. Masson & Cie., Publishers, Paris.

As the title of this excellent little book implies, its contents are not of primary interest to the roentgenologist. The treatment of infected wounds only calls for the aid of the latter, when it is desirable, among other contingencies, to control the progress of the healing of compound fractures, and it is in this connection that the authors reproduce a number of roentgenograms illustrating the satisfactory progress which badly infected wounds of war origin have made under the special treatment they advocate. This treatment consists in the systematic application of the Carrel-Dakin method which has of late aroused the favorable attention of surgeons and internists alike. The authors give precise instructions for the preparation and application of the Dakin disinfecting fluid and call attention to the extreme importance of thoroughly understanding these details before applying the method. In fact, they attribute failures in the hands of others solely to the want of adequate mastery of the technic. This "apprenticeship" requires at least several weeks even for an experienced surgeon, but the time is well spent as the results are sure to be satisfactory even in cases where older methods are useless.

Although the book is written in French, the terminology employed is so simple that a physician acquainted with the fundamentals of the language will be able to understand it. The book may be obtained in this country from the publisher of this journal.

MEDICINE AND SURGERY, June, 1917. Annual Subscription $3.00; single copies 30 cents. Published by Medicine and Surgery Publishing Co., St. Louis, Mo.

The June number of this recently created magazine is almost entirely devoted to roentgenological diagnosis and treatment and contains a number of articles which, while not going as deeply into technical matters as journals would that are exclusively devoted to this specialty, furnish matter of value and interest to the roentgenologist.

Dr. Emil G. Beck contributes a paper on the advantages of the stereoscopic method and incorporates therein a summary of his early as well as most recent experiences in the use of roentgenographic stereoscopy. He recommends the universal adoption of this method for all cases with a very few exceptions, such as making lateral roentgenograms of the spine to show defects in the bodies of the vertebræ or in cases where we have simply to prove the presence of a foreign body and not its location. Otherwise, he holds, the stereoscopic roentgenogram is indispensable.

A. Hyman, in writing on the difficulties of interpretation of renal and ureteral roentgen shadows, thinks that the roentgen method is the most valuable at our disposal in the detection of renal and ureteral calculi, provided it is used in conjunction with the other established methods. In order to avoid errors of interpretation in these regions, special precautions must be used. Corroborative evidence furnished by stereoscopy, the shadowgraph catheter, pyelography, and ureterography (the latter preferably combined with stereoscopy) are absolutely indicated in all doubtful cases.

Maximilian J. Hubeny deals with the roentgen examination of the chest, pointing out the advantages derived from its employment in a number of thoracic affections and irregularities. In this way he deals with the esophagus, drop heart (asthenic heart), angina pectoris, aneurysm of the thoracic aorta, pericardial effusions, miliary tuberculosis, fibrosis with consequent displacement of the trachea, chronic indurated fibroid phthisis of the lung with compensatory emphysema of the opposite side, metastatic carcinomatosis, sarcomatous infiltration secondary to sarcoma of head of humerus, mediastinal tumor (endothelioma), hydropneumothorax, and pleurisy with effusion — all of which are illustrated by roentgenograms.

Roentgenotherapy in malignant tumor of the parotid salivary gland forms the subject of Chas. A. Pfender's contribution. The literature does not abound with case reports of malignant tumors of the salivary parotid gland treated

either by radium or roentgen rays, for the simple reason that few men have had opportunity to employ radium on account of its expense, while roentgenotherapy until quite recently had not perfected a technic which enabled the operator to destroy the tumor mass without injury to the patient. The author recalls what was probably the first case of sarcoma of the parotid treated by roentgen rays in 1908 by Bataille and Méret, of Rouen, France. The course of this case was interesting. The first operation was followed in 15 days by recurrence. Then roentgenization appeared to check the progress of the sarcoma but did not destroy the tumor cells, as the microscopic study showed karyokinetic figures in the sections. The second operation was not complete either but was immediately followed by roentgenization with complete recovery in two weeks. At the time of the report, eight months had elapsed with no sign of recurrence.

In conclusion the author reports three inoperable cases treated by roentgen rays. In the first case the patient died from multiple metastases; the second patient was entirely well six months after treatment and the prognosis of the third case was unfavorable due to low general vitality. Death was due to exhaustion.

A. C. Christie writes on the diagnosis of bone tumors, taking as a basis the classification as given in Bryant and Buck's "Practice of Surgery," combined with Bloodgood's classification of secondary cysts. The differential diagnosis of bone tumors is summed as follows: Exostoses may be accurately diagnosed by their roentgen appearance. Chondroma when growing laterally from the epiphysis gives a typical roentgen picture, and multiple enchondromata are readily recognized. Single chondroma occurring centrally may be mistaken for benign cyst or giant-celled sarcoma, but the treatment is practically identical for all three. Periosteal sarcoma may be confused with tuberculosis, osteomyelitis, syphilis or Charcot's joint, and the greatest care is necessary to differentiate them. Multiple myeloma and endothelioma are rare. The former can usually be recognized, but the latter can not be distinguished clinically from sarcoma. Benign cysts are likely to be confused only with chondroma or giant-celled sarcoma. Carcinoma of bone may be confused with tubercular disease, especially in the spine, but if care is taken in examining for areas of regeneration and to discover the primary cancer, a mistake is usually avoided.

Syphilitic pleurisy with effusion is either an unusual lesion or one that escapes identification, according to P. G. Skillern, who presents a roentgenogram of right side of thorax, showing columnar area of syphilitic thickening of pleura. A dark area extends along the lateral wall of the thorax from axilla to diaphragm and helped to clear up the diagnosis.

Samuel B. Childs reports a case of a gallstone in the ampulla of Vater and reproduces a roentgenogram intending to show the common duct and the right and left hepatic ducts after bismuth injection, with the gallstone at the lower end of the duct, but it is unfortunate that the illustration could not have been reproduced more clearly.

In an article on the treatment of malignancy by radium, Russell H. Boggs arrives at the following conclusions:

Operable growths should be operated, except certain types of epithelioma, and then have after-treatment by roentgen rays or radium. Leading surgeons are beginning to recognize radium as a legitimate means of treatment. One of the most striking results of radium treatment is the disappearance of offensive secretions in almost every case. Every advanced or inoperable case should be treated with radium, for palliation at least. In the past, the treatment of hopeless carcinoma cases has been morphine; to-day it should be radiotherapy.

The "X-ray and Radium Treatment of Leukemia and Hodgkin's Disease" is the subject of a paper by Isaac Levin. A great many attempts have been made to show that these diseases are of an infectious origin and caused specific microörganisms, but there is no definite evidence, according to this author, that any of this class of diseases are caused by an infectious agent and it seems more plausible, for the present at least, to maintain that they are closely related to malignant neoplasms. Levin's paper intends to show that the results of roentgen and radium therapy bear out this contention.